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Bonn zoological Bulletin

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Editorial

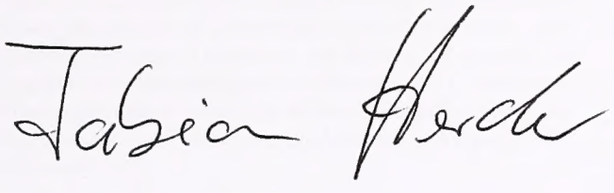
Welcome to the 60th volume of the Bonn zoological Bulletin. All contents published since 1950 are now available online at the ZFMK homepage, providing open access to numerous contributions to organismal zoology. The journal has now been added to the Directory of Open Access Journals, further improving the visibility of papers published in the BzB. Besides open access status, publication remains free of charge for authors, including colour illustrations. In sum, the journal is increasingly attractive for the publication of sound scientific work from its three focus fields, namely (1) taxonomy, (2) systematics and evolution, and (3) biodiversity and biogeography.

Taken together, 32 scientific papers and 10 catalogues of type specimens housed at ZFMK were published in more than 730 pages in the first year after changing the BzB title from "Bonner zoologische Beiträge" to "Bonn zoological Bulletin". The papers contain, among other topics, descriptions of more than a dozen species new to science, ranging from butterflies to fishes, frogs and snakes.

The current issue adds new species records, a comprehensive checklist, descriptions of five new species, and further contributions to organismal zoology. A molecular study suggests that an Amazonian *Pecari* described a few years ago likely does not represent a valid species, and a case study conducted on a small tropical island reports on the accumulating species richness data in a herpetological field survey.

Last but not least, it's an honour to welcome two new board members. Philipp Wagner, currently at Villanova University (USA), is a herpetologist and well known to BzB readers. He has a special interest in agamid lizards from Africa, has acted as guest editor previously, including last year's special issue "Herpetologia Koenigiana" in honour of Wolfgang Böhme, and will now join the Editorial Board. Tan Heok Hui from Raffles Museum of Biodiversity Research in Singapore will support the BzB team as a member of the Advisory Board. He is famous among ichthyologists, especially for his taxonomic work on Asian freshwater fishes including sucker loaches, fighting fish, and the smallest fish species recorded so far, a cyprinid. His interests include also herpetology and vertebrates as well as invertebrates occurring in marine, brackish and freshwater habitats of Asia. A warm "welcome on board" to both colleagues!

With best wishes to all readers, authors and "BzB-team" members,



Fabian Herder (Editor-in-Chief, Fish Curator at ZFMK)
Bonn, April 2011

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Estimating the herpetofaunal species richness of Pangkor Island, Peninsular Malaysia

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Abstract. Herpetological surveys of Southeast Asian tropical ecosystems rarely, if ever, result in complete inventories. This is due to the fact that surveying to completion requires huge investments in terms of search effort. As a result, the presented species lists usually represent subsets of the total herpetofaunal assemblage and consequently do not shed light on the total species richness of the investigated area. This is regrettable as species richness is an elementary measure of biodiversity that underlies many ecological models and conservation strategies. By recording not just species but species per unit of search effort, an extended dataset results which can be used to generate estimates of total species richness. In this study, the herpetofauna of Pangkor Island, Peninsular Malaysia is used as an example. In 2009 and 2010, the first herpetological surveys were carried out on this small, 18 km^2, island. Those surveys recorded 43 species of reptiles and 13 species of amphibians. In this study, total reptile species richness was estimated by fitting several models to the sample-based rarefaction curve as well as by application of the nonparametric Chao-I estimator. Of the applied models, the 4-parameter Weibull function was shown to be superior, a finding that is in line with several other studies. Consequently, the use of this model is recommended. On the basis of the fitted 4-parameter Weibull-function, 69 reptile species are expected to occur on Pangkor Island. As for amphibians, total species richness was estimated to be 17. As such, a remarkably extensive herpetofaunal assemblage inhabits this small island.

Key words. Pangkor Island, Malaysia; amphibians, reptiles, species-richness, sample-based rarefaction curve, negative exponential function, 3-parameter Weibull function, 4-parameter Weibull function, Chapman-Richards model, Chao-I estimator

INTRODUCTION

Herpetological surveys of species-rich tropical ecosystems rarely result in complete inventories (e.g. Lloyd et al. 1968; Murphy et al. 1994; Hofer & Bersier 2001; Van Rooijen 2009). This is due to the asymptotical nature of the species accumulation process in combination with limited survey-investments. As a consequence, the use of estimation techniques is unavoidable when the intended objective is to assess species richness, an elementary measure of biodiversity that underlies many ecological models and conservation strategies. One such estimation technique consists of fitting an appropriate function to the species accumulation curve. The asymptote of the fitted functions can then be regarded as an estimate of total species richness. Species accumulation curves are regularly applied in herpetofaunal surveys but they are mostly used to arrive at qualitative judgements about the exhaustiveness of the survey (e.g. Murphy et al. 1994; Zug et al. 1998; Ziegler 2002). However, extensive and sophisticated literature exists pertaining to methods and models used to quantitatively estimate species richness, on the basis of either rarefied species accumulation curves or abundance patterns (e.g. Colwell & Coddington 1994; Flather 1996; Gotelli & Colwell 2001; Longino et al. 2002; Brose et al. 2003).

The offshore archipelagos of Peninsular Malaysia have been the subject of increasing interest in recent years. Many of these islands have never been surveyed and recent explorations are only beginning to uncover the hidden diversity and endemism that they shelter (Chan et al. 2009a; Grismer 2008; Grismer & Norhayati 2008; Grismer & Pan 2008; Grismer et al. 2008, 2009a, b). One such

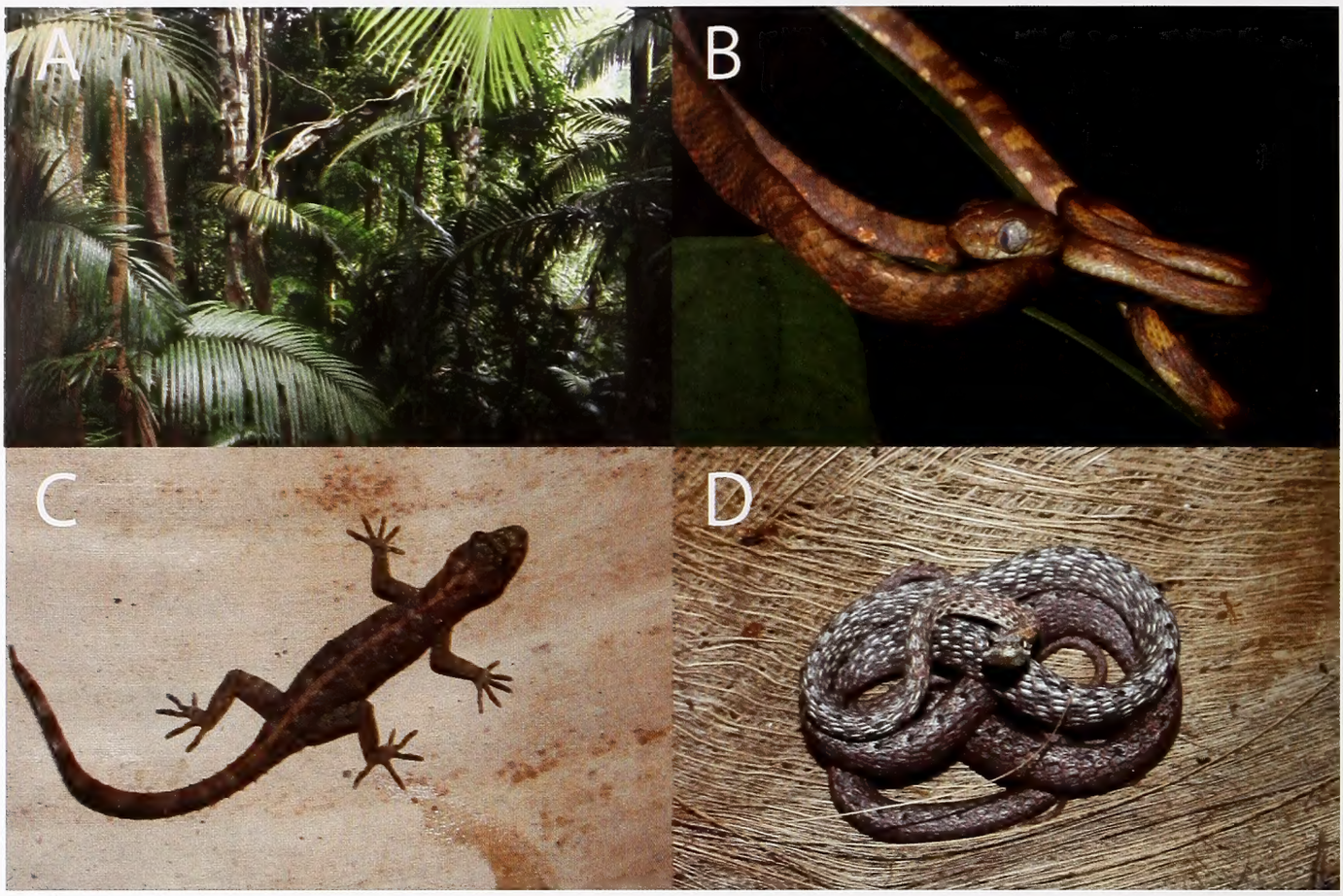

Fig. 1. A: View into the primary forest of Pangkor Island; B: *Boiga drapiezii* (Boie, 1827); C: *Cnemaspis shahruli* Grismer et al., 2010; D: *Dryophiops rubescens* (Gray, 1835).

island is Pulau Pangkor, approximately 18 km^2 and situated 3.5 km from the west coast of Peninsular Malaysia. The island's interior remains heavily forested and maintains a river system, Sungai Pinang, which supplies a significant source of permanent fresh water in the form of multiple streams. Chan et al. (2010) provided the first report on the (non-marine) herpetofauna of this island and documented 43 reptiles and 13 amphibians. A few illustrations are provided in figures 1 and 2.

The study described in this paper had a dual objective. First, data collected by Chan et al. (2010) were used to evaluate the performance of several estimators. Second, the most appropriate estimator was used to estimate the total herpetofaunal species richness harboured by Pangkor Island, West Malaysia.

MATERIAL AND METHODS

The data underlying this study were based on the surveys carried out by Chan et al. (2010). These were conducted in the periods March 15–17, May 4–8, June 13 to July 8, 2009, and February 22 to March 8, 2010. During the latter two periods, only reptiles were surveyed. Marine reptiles were ignored altogether. The predominantly applied survey method corresponds to visual encounter survey (VES), a simple method which has been shown to be effective for surveying rainforest herpetofauna (Doan, 2003). VES was carried out both during day and night (e.g. Coddington et al., 1996; Doan, 2003) in a way similar to that applied by Minh (2007). Existing trails as well as several trails made by the Department of Forestry of Perak and Peninsular Malaysia were used. These trails traversed dipterocarp forest, mangrove forest and cultivated areas and provided ample access to forest streams. The second collection method consisted of searching for road-kills. The third entailed turning logs, fallen tree bark and similar objects in order to uncover animals hiding underneath. Sampling effort was expressed in terms of search-days where one search-day was defined as roughly 4.5 search-hours. As two of the surveys underlying the data collected by Chan et al. (2010) focused solely on reptiles, substantially more information was available regarding reptiles allowing for more thorough analyses. Therefore, this study focuses predominantly on reptiles, amphibians being treated separately and in less detail.

Sample-based rarefaction curves (Gotelli & Colwell 2001) were generated with the program EstimateS (Colwell

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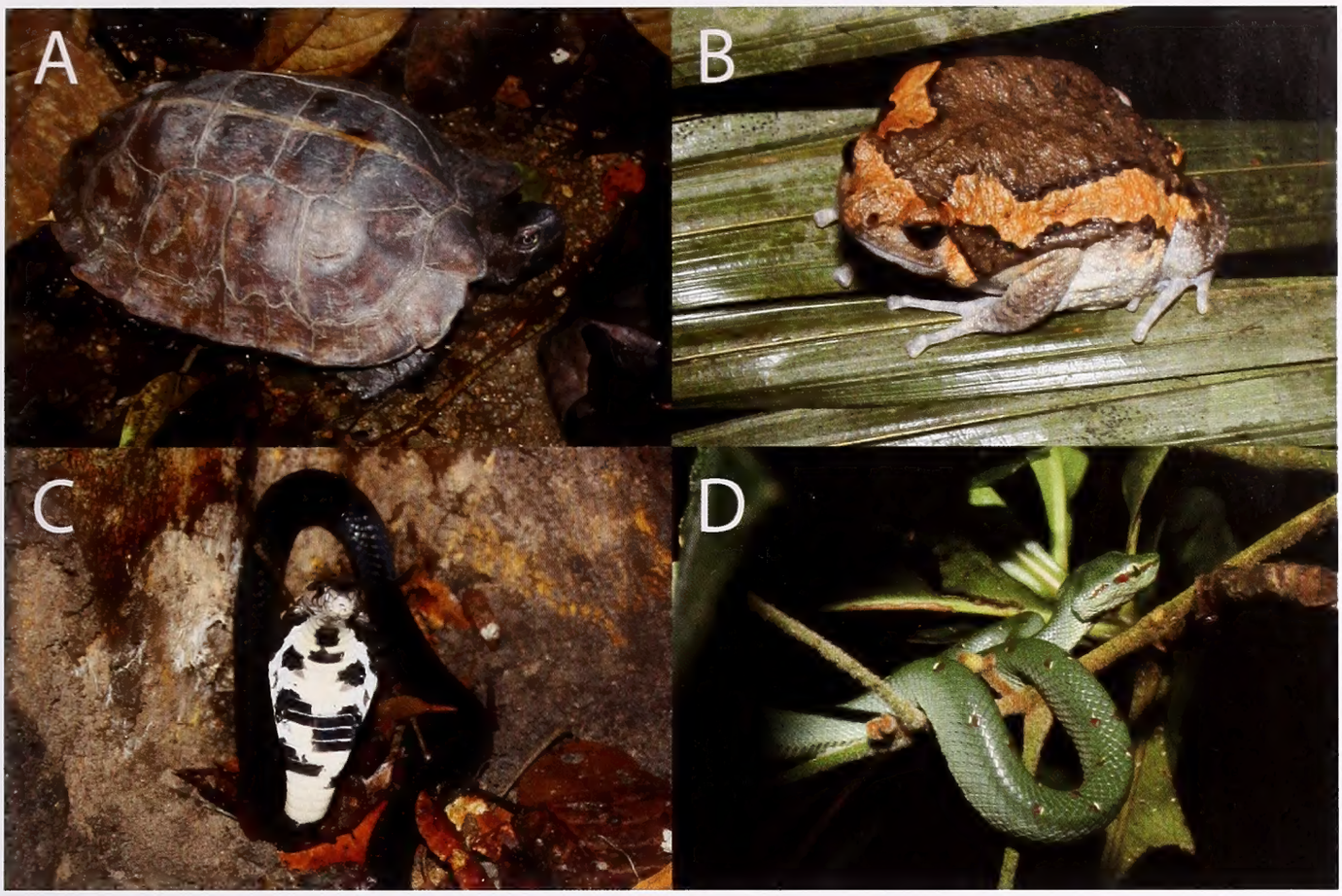

Fig. 2. A: *Heosemys spinosa* (Gray, 1831); B: *Kaloula pulchra* Gray, 1831; C: *Naja sumatrana* (Müller, 1890); D: *Tropidolaemus wagleri* (Boie, 1827).

2005). Four models were fitted to the rarefaction curve. The first corresponds with a negative exponential model (Colwell & Coddington 1994; Flather 1996; Van Rooijen 2009). It is based on the assumption that the number of new species found per search day is proportional to the number of as yet undiscovered species, in mathematical terms: $dY/dt = c\ (A–Y)$ where A is the total number of species present in the area under investigation, Y is the total number of species found and c is a constant. This equation can be represented as a negative exponential function (e.g. Van Rooijen 2009): $Y = A\ (1–e^{-ct})$. The basic assumption underlying the negative exponential model (henceforth NE) may be overly simplistic given that abundance patterns are usually strongly skewed (e.g. Lloyd et al. 1968; Coddington et al. 1996; Limpert et al. 2001; Longino et al. 2002; Thompson et al. 2003). In order to model more complex species accumulation processes, the NE can be refined in various ways by adding one (d) or two parameters (d and p), resulting in the Chapman-Richards model (henceforth CR), 3- and 4-parameter Weibull cumulative distribution functions (henceforth 3pW and 4pW):

$$Y = A\ (1–e^{-ct})^{d}\ \text{(CR)},$$
$$Y = A\ (1–e^{-(ct)^{d}})\ \text{(3pW)},$$
$$Y = A\ (1–e^{-(c(t-p))^{d}})\ \text{(4pW)}$$

The four models were fitted to the sample-based rarefaction curve using nonlinear regression analysis (e.g. Norusis and SPSS 1994) with SPSS (release 14 February 1996; SPSS Inc.).

Extrapolation using different models for the species accumulation process can provide different asymptotes and thus predict different values of species richness (e.g. Colwell & Coddington 1994; Flather 1996). Therefore, care has to be taken to select the most appropriate model in order to minimize bias. In this study, the appropriateness of each model was evaluated on the basis of three criteria. The first criterion was goodness-of-fit. The second criterion entailed the behaviour of the richness-estimate with increasing cumulative search effort. The final criterion was the difference with the nonparametric Chao-I estimator (Chao 1984; Coddington et al. 1996; Hofer & Bersier 2001; Veith et al. 2004). This estimator is an often applied representative of a class of estimators that uses a different approach as they are based on abundance patterns instead of the accumulation curve. The Chao-I estimator is based on the observed number of rare species, $A = Y + (a^2/2b)$, where A is the total number of species, Y is the observed number of species, a is the number of observed species represented by a single specimen and b

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is the number of observed species represented by exactly two specimens.

RESULTS

Figure 3 depicts the deviations of the fitted functions from the sample-based rarefaction curve (residuals) for reptiles. As expected, the NE exhibits a very poor goodness-of-fit. At first, the fitted curve is situated beneath the rarefaction curve, then above and finally drops beneath the rarefaction curve again. The suboptimal fit of the NE as well as the pattern of residuals are in agreement with results obtained with regard to avian diversity (Flather 1996) as well as snake diversity (Van Rooijen 2009). Although the RC and 3pW fit substantially better than the NE, they exhibit a similar pattern of residuals. The 4pW function obviously exhibits a superior, near-perfect, fit.

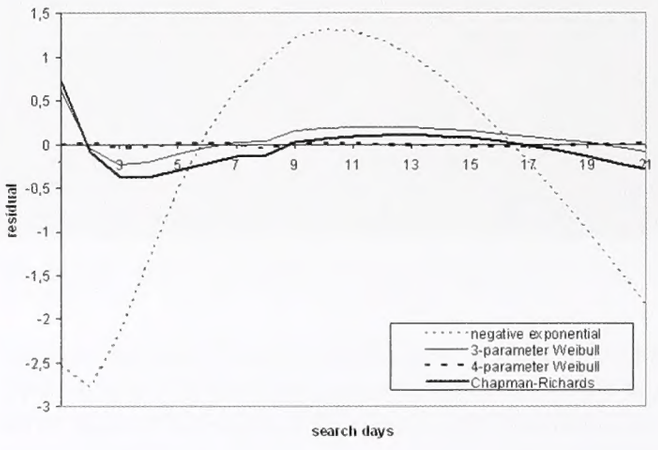

Fig. 3. Deviations of the fitted models from the sample-based rarefaction curve (residuals).

Figure 4 depicts the sample-based rarefaction curve as well as the fitted 4pW. The only noticeable deviation of the fitted 4pW from the rarefaction curve lies in the fact that it passes through (p,0) instead of the origin (0,0). The close fit of the 4pW is in agreement with results obtained in studies of avian diversity (Flather 1996), snake diversity (Van Rooijen 2009) and diversity of small reptiles (Thompson et al. 2003). The progression of the rarefaction curve clearly indicates that an asymptote has not yet been reached, thus the surveys have not been exhaustive.

Figure 5 shows how the richness estimates (as opposed to observed richness or fitted model-values) develop with increasing search days during the second half of the survey. The NE is neglected due to its poor fit. Evidently, the 3pW- as well as CR-based estimates are still increasing at the end of the survey whereas the 4pW-based estimate

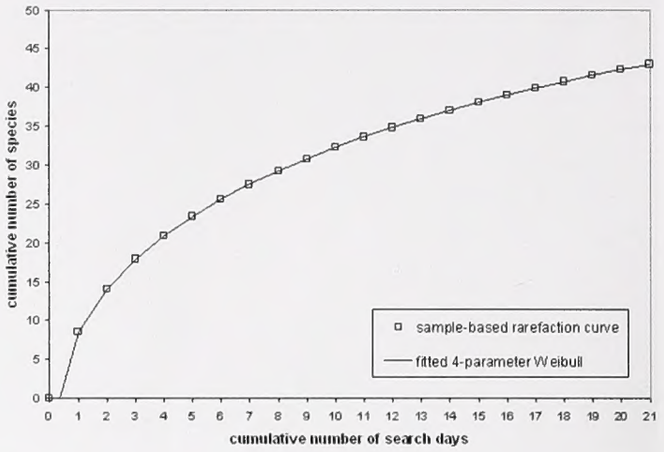

Fig. 4. Reptile species sample-based rarefaction curve with fitted 4-parameter Weibull function.

has reached a more or less stable level. A similar result (unpublished) was obtained on the basis of a dataset that underlies a study of Bornean snakes (Van Rooijen 2009): the 4pW-based estimate reached an approximately stable plateau rather early with the CR- and 3pW-based estimates approaching the 4pW-based estimate with increasing search days.

On the basis of these results, the 4pW-based estimate, 69, is assumed to be the least biased. Finally, the estimate based on the nonparametric Chao I estimator, 62, agrees reasonably well with the 4pW-based estimate. Taking the average, 65 reptile species are expected to inhabit Pangkor Island. As for amphibians species richness, the fitted 4pW and Chao I estimator both resulted in an estimate of 17 species.

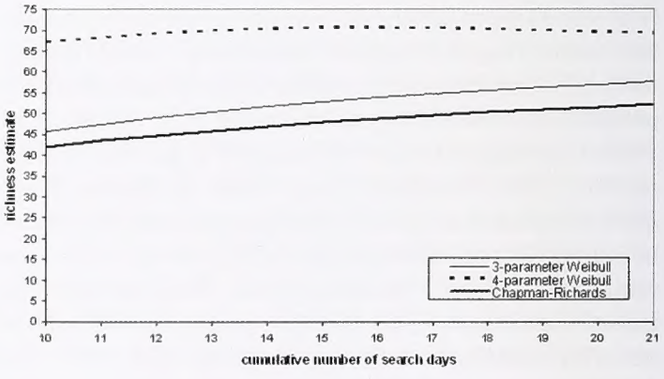

Fig. 5. Richness estimates in relation to cumulative search effort.

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DISCUSSION

Estimation by extrapolation, as opposed to interpolation, into the unknown entails a high degree of uncertainty. However, the alternative, surveying until completion, is simply unfeasible when the survey is aimed at the herpetofauna of a Southeast Asian rainforest ecosystem (Van Rooijen 2009). As such, there simply is no alternative. Thus, further refinement of estimation methods is of importance. That said, approximately complete species lists are obviously still crucial for many zoogeographic studies. Such species lists can be (and are) compiled by combining results of various surveys. However, this usually entails the combination of species lists pertaining to different locations. As such, completeness comes at a price as one has to accept a huge decrease in spatial resolution. In most zoogeographic studies however, a high resolution is not essential as species compositions of major land masses are compared (e.g. In Den Bosch 1985; How and Kitchener 1997; Inger and Voris 2001). At the spatial scale which is relevant for conservation though, complete species lists are a utopia in the majority of cases and estimation will therefore gain in importance (Van Rooijen 2009). This study underscores the notion that a combination of criteria needs to be applied to select the most appropriate estimator. The 4-parameter Weibull function exhibited the highest goodness-of-fit. Moreover, it produced the most stable estimate near the end of the survey (figure 5). Finally, it resulted in a richness-estimate that agreed well with the estimate based on the nonparametric Chao-I estimator. Even then, the estimate may be downwardly biased due to suboptimal sampling. First of all, although searches were carried out during both day and night, no searches were performed in the early morning (before dawn). Secondly, sampling of canopy-microhabitat was obviously unfeasible. Finally, as true species richness is underestimated by most estimators when sample size is small (Colwell & Coddington 1994; Canning-Clode et al. 2008), the estimate of amphibian species richness may be downwardly biased since it was based on only five search days. Nevertheless, the amphibian species richness appears to be rather low which is in agreement with the impression of herpetologists who carried out the surveys (Chan et al. 2010).

The fact that the 4-parameter Weibull function exhibits such a good fit when applied to diverse ecological communities such as small reptiles in desert habitat (Thompson et al. 2003), birds (Flather 1996) and reptiles in rainforest habitat (Van Rooijen 2009 and this report) is striking. Two explanations can be put forward. First, relative species abundances follow very similar patterns over a wide range of ecological communities: relatively few species are abundant whereas most are rare (e.g. Hughes 1986). Thus, the shape of the species accumulation process may also be expected to be rather uniform. Second, the higher the number of parameters of a model, the better the fit. Thus, the 4pW may simply be expected to fit better than similar functions with fewer parameters, irrespective of the field of application.

65 reptilian species are estimated to inhabit Pangkor Island, 43 of which have been recorded (Chan et al. 2010). A major part of the as yet unrecorded species will concern snakes as members of this taxon are notoriously hard to find due to their elusive habits and low densities (e.g. Lloyd et al. 1968; Inger & Colwell 1977; Hofer & Bersier 2001; Orlov et al. 2003; Van Rooijen 2009). This notion is strengthened by several indirect observations. Locals provided accounts regarding observations of *Boiga dendrophila* (Boie, 1827), *Cryptelytrops purpureomaculatus* (Gray, 1832), *Ophiophagus hannah* (Cantor, 1836) and *Maticora bivirgata* (Boie, 1827). In addition, there has been a visual record of a *Coelognathus radiatus* (Boie, 1827) (Schultz, pers. comm.). As amphibian species richness is estimated to be at least 17, herpetofaunal species richness is expected to equal at least 82 species, which is quite impressive given the fact that Pangkor Island encompasses merely 18 km^2. On the other hand, whether Pangkor Island harbours a comparatively extensive herpetofauna is impossible to determine at the moment as species richness on other Malaysian islands has not yet been estimated.

Estimating species richness of specific sites such as islands obviously has added value as species richness is an elementary criterion a conservationist may use when selecting sites and is crucial for many ecological studies. However, the function fitted to the rarefaction curve not only provides an estimate of total species richness but also provides insight in expected return on further investment: how many previously unrecorded species may be expected to be found with additional search effort? For instance, on the basis of the fitted 4-parameter Weibull function, ten previously unrecorded reptiles are expected to be found on Pangkor Island when 20 additional search days are invested. Such statistical expectations can be used as input for a cost-benefit evaluation when choices have to be made between different sites for the investment of survey-capacity. Alternatively, one might determine how much search effort would have to be invested to bring the survey to some specified level of completeness.

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New records of snakes from Cat Tien National Park, Dong Nai and Lam Dong provinces, southern Vietnam

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Abstract. We report ten new records of snakes from Cat Tien National Park, Dong Nai and Lam Dong provinces, southern Vietnam. The specimen of *Typhlops siamensis* Günther, 1864 from Cat Tien represents the second country record in Vietnam after more than one century. Our new record of *Dendrelaphis ngansonensis* (Bourret, 1935) leads to a considerable range extension of this species, so far known only from northern and central Indochina. Additional specimens of *Oligodon deuvei* David, Vogel & van Rooijen, 2008 are described, along with the first photograph of a living specimen, showing the coloration including the aposematically red-coloured underside of the tail. An updated checklist of snakes of the Cat Tien National Park is also provided.

Key words: Squamata: Serpentes: Typhlopidae, Colubridae, Cat Tien National Park.

INTRODUCTION

Among the 545 species of reptiles and amphibians known from Vietnam, snakes have the highest species diversity (Nguyen et al. 2009). However, many snake species are often recorded only by a single or rather few specimens, and data on their distribution and natural history are still deficient. Though the Cat Tien National Park is the biggest and most important National Park for the lowland rainforests of southern Vietnam (Polet & Ling 2004), its herpetofauna is still poorly studied (Nguyen 1988, Le et al. 1998, Nguyen & Ho 2002, Le 2007, Geissler et al. 2009). The most recent checklist of reptiles and amphibians of the Cat Tien National Park, which was compiled by Nguyen & Ho (2002), reported a total of 42 snake species. We herein provide an updated checklist of snakes from this national park with ten new records and discussion about the status of some rare and poorly known species in Vietnam.

MATERIAL AND METHODS

Field work was conducted by Peter Geissler in July and August 2008 and from March until June 2009; by Nikolay A. Poyarkov from November until December 2007, from February until April 2008, from February to April 2009, and in July 2010 in Cat Tien National Park, Dong Nai Province, southern Vietnam (Fig. 1). Species identifications were also based on the examination of specimens collected by colleagues from the Appalachian State University (North Carolina, USA). A total of 54 specimens were examined and they were subsequently deposited in the collections of the Institute of Ecology and Biological Resources (IEBR), Hanoi, Vietnam; the Zoologisches Forschungsmuseum Alexander Koenig (ZFMK), Bonn, Germany; and the Zoological Museum, Moscow State University (ZMMU), Moscow, Russia.

The following measurements were taken with a digital vernier calliper: SVL (snout-vent length); TL (total

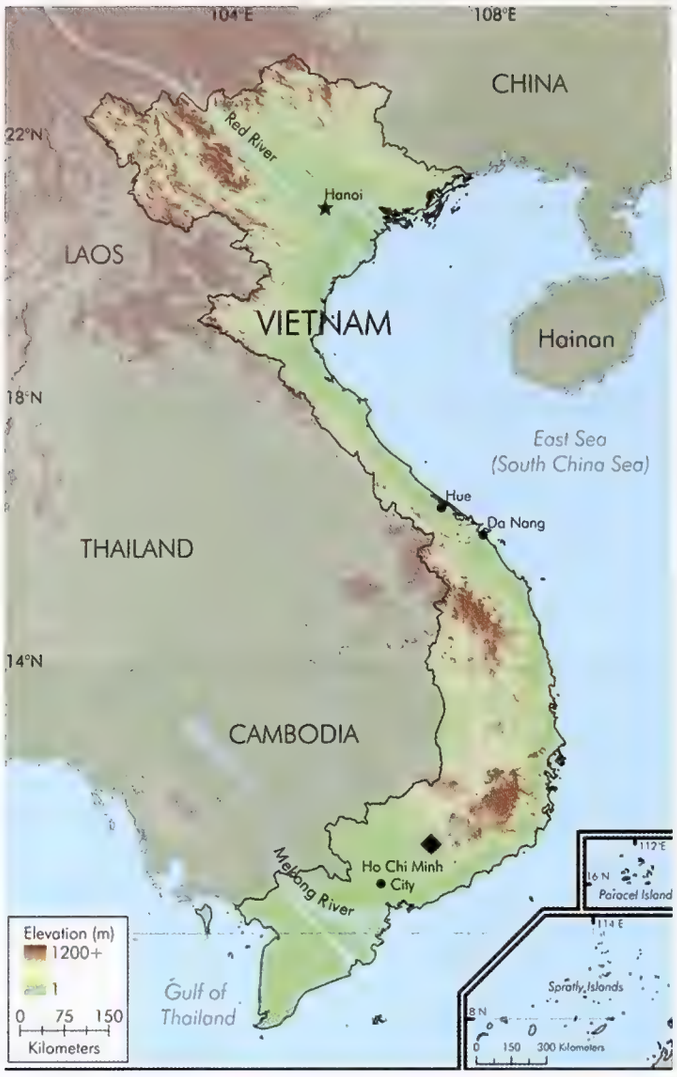

Fig. 1. Map showing the study site (black diamond) in southern Vietnam: Cat Tien National Park.

length); TaL (tail length). In addition, several scale counts were taken: VEN (number of ventrals); MD (middorsal scales); MBS (midbody scale rows, including the ventrals); SC (subcaudals); IL (infralabials); SL (supralabials).

TAXONOMIC ACCOUNT

Typhlops siamensis Günther, 1864

Specimen examined: One adult male (ZFMK 88922), collected by P. Geissler on the road in a rainy evening on 31 March 2009, at the Headquarters of Cat Tien National Park, Dong Nai Province (near 11°25'19.3"N, 107°25'42.0"E, 104 m a.s.l.).

Characteristic features: The morphological features of this specimen fit the descriptions of Günther (1864) and Wallach (2001): SVL 140.2 mm; TL 4.4 mm; preocular separated from nasal; inferior nasal suture contacting second supralabial; superior nasal suture extending horizontally to rostral, not visible from above; 22 scale rows around midbody (including ventral scale rows); 308 paravertebral scales (306–368 according to Wallach 2001); dorsum uniformly dark brown, venter cream (see Fig. 2a).

Remarks: Wallach (2001) limited the distribution of this species to Thailand and Cambodia, although it was recorded from Vietnam by Nguyen & Ho (1996), see also Nguyen et al. (2009). The record is based on a specimen (ZISP 5426), which was collected by Tramond in 1879 and subsequently deposited in the collection of the Zoological Institute in St. Petersburg (Tirant 1885). Therefore, our record from Cat Tien National Park represents a rediscovery of this species in Vietnam after 130 years. In mainland Southeast Asia, both *Typhlops diardi* Schlegel, 1839 and *Typhlops muelleri* Schlegel, 1839 are morphologically similar to *Typhlops siamensis*. *T. siamensis* differs from *T. diardi* in having a lower number of scale rows around midbody (22 vs. 24–28). Bourret (1936) synonymized *T. siamensis* with the subspecies *T. diardi nigroalbus* Duméril & Bibron, 1844. *Typhlops diardi nigroalbus* was recently synonymized with *Typhlops muelleri* Schlegel, 1839 by Wallach (2001). *T. siamensis* can be distinguished from *T. muelleri* by having a lower count of MBS (22 vs. 24–30) and by the absence of a sharply bounded yellow ventral surface. However, *T. muelleri* was not included in recent lists of the snake fauna of Vietnam (Ziegler et al. 2007, Nguyen et al. 2009). We thus follow Wallach (2001) to recognize *T. siamensis* as a distinct species. Future research on *Typhlops* from southern Vietnam is required to show whether *T. muelleri* actually occurs in Vietnam as affirmed by Wallach (2001) or these records are based on misidentified specimens of the closely related *T. siamensis*.

Boiga multomaculata (Boie, 1827)

Specimen examined: One adult male (ZFMK 88923), collected by K. D. Le in August 2008 in the bamboo forest, Cat Loc area, Lam Dong Province (near 11°37'22.5"N 107°17'57.2"E, 135 m a.s.l).

Characteristic features: The morphological features of this specimen agree with the descriptions of Bourret (1936), Smith (1943), and Campden-Main (1970): SVL 588 mm; TaL 158 mm; 1 loreal; 1 preocular; 2 postoculars; 8 SL; 10 IL; 19 MD; 215 VEN; 93 SC; head with two dorsal dark brown stripes, from snout to neck. For colouration in life see Fig. 2b.

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Fig. 2. **a.** *Typhlops siamensis* (ZFMK 88922); **b.** *Boiga multomaculata* (ZFMK 88923); **c.** *Calamaria pavimentata* (ZFMK 88924); **d.** *Coelognathus flavolineatus* (ZFMK 88898). Photographs: E. Galoyan & P. Geissler.

Calamaria pavimentata Dumeril & Bibron 1854

Specimen examined: One subadult specimen (ZFMK 88924), collected by K. D. Le in June 2008, in Cat Loc area, Lam Dong Province (near 11°37'22.5"N 107°17'57.2"E, 135 m a.s.l).

Characteristic features: The morphological features of this specimen fit the descriptions of Bourret (1936), Smith (1943), and Ziegler et al. (2007): SVL 208 mm; TaL 15.9 mm; snout obtuse; no supranasals; no loreals; no temporals; 13 MD (smooth); 158 VEN; 17 SC; dorsum dark brown or grey; 6 black dorsolateral stripes; yellow collar, narrowing dorsally; tail with 2 yellow cross bands. For colouration in life see Fig. 2 c.

Remarks: This is the southernmost record of this species from Vietnam (compared with Nguyen et al. 2009).

Coelognathus flavolineatus (Schlegel, 1837)

Specimen examined: One adult female (ZFMK 88898), collected by P. Geissler in April 2009, on the forest floor, in a mixed forest near Bau Sau Lake, Cat Tien National Park, Dong Nai Province (near 11°27'32.9"N 107°20'43.7"E, 167 m a.s.l.).

Characteristic features: The morphological traits of this specimen agree with the descriptions of Bourret (1936) and Smith (1943): SVL 1,307 mm; TaL 374 mm; 1 elongated loreal; 1 preocular; 2 postoculars, 8 SL; 10 IL; 19 MD, keeled; 212 VEN; 96 SC, divided; dorsum brown, with a orange, black edged vertebral stripe; vertebral stripe desappearing in the posterior half of body, which is uniformly dark brown. For colouration in life see Fig. 2d.

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Fig. 3. **a.** *Dendrelaphis ngansonensis* (ZFMK 88913); **b.** *Lycodon subcinctus* (adult, IEBR A.2010.42); **c.** *Lycodon subcinctus* (juvenile, ZFMK 91899); **d.** *Oligodon deuvei*(ZMMU NAP-02811); **e.** *Oligodon ocellatus* from Cat Tien National Park, Dong Nai Province (e); **f.** *Xenochrophis flavipunctatuss* (ZFMK 88914). Photographs: E. Galoyan, P. Geissler, W. Van Devender.

***Dendrelaphis ngansonensis* (Bourret, 1935)**

Specimens examined: One adult male (ZFMK 88913), collected by P. Geissler on 22 July 2008, in a secondary forest near Bau Sau Lake, Cat Tien National Park, Dong Nai Province (near 11°27'32.9"N, 107°20'43.7"E, 160 m a.s.l.). It was found in the morning, basking on a sunny spot on the lava-rock-covered forest floor.

Characteristic features: The characters of the specimen fit the descriptions given by Bourret (1935, 1936) and Ziegler & Vogel (1999): SVL 824 mm; TaL 419 mm; 25 dentary teeth; 15 MD; 188 VEN (165–199 in the description of Ziegler & Vogel 1999); 153 SC; vertebral dorsals enlarged; dorsum bronze-brown; presence of a distinct black stripe from the posterior margin of the eye to the neck; scales on dorsilateral neck and anterior part of body with bluish margin. For colouration in life see Fig. 3a.

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Remarks: According to Ziegler & Vogel (1999) and Nguyen et al. (2009) this species has been known only from northern and central Vietnam and Quang Nam Province has been known to be the southernmost locality of the species' range. Our record from Cat Tien National Park extends the known distribution about 500 km southwards to the lowland forests of southern Vietnam (see Fig. 3). The distribution gap seen in the map leads to the suggestion that *D. ngansonensis* is also present on or along the Central Highlands as well as the Da Lat Plateau. Like in other localities in Vietnam (Ziegler & Vogel 1999), *Dendrelaphis pictus* (Gmelin, 1789) can be found in the same habitats with its congener, affirming the species status of *D. ngansonensis,* which was originally considered as a subspecies of *D. pictus.*

Lycodon subcinctus Boie, 1827

Specimens examined: One adult male (IEBR A.2010.42), collected by W. Van Devender in June 2004, near the headquarters of Cat Tien National Park, Dong Nai Province (near 11°25'19.3"N, 107°25'42.0"E, 104 m a.s.l.). One juvenile (ZFMK 91899), collected by W. Van Devender on 9 June 2004, near Suoi Rang Ranger Station, Cat Tien National Park, Dong Nai Province. One juvenile (IEBR A.2010.43), collected by W. Van Devender in 2006 in Cat Tien National Park, Dong Nai Province.

Characteristic features: The morphological traits of the specimens (data given in the following order: IEBR A.2010.42/ZFMK 91899/IEBR A.2010.43) fit the descriptions of Smith (1943); Daltry & Wüster (2002), and Ziegler et al. (2007): SVL 651 mm / 276 mm / 228 mm; TaL 159 mm / 65 mm / 55 mm); head with broad blunt snout; preocular absent; prefrontal and loreal in contact with the eye; 8 SL, 4 suboculars; 17 MD, smooth; 201/202/201 VEN; precloacal scale divided; 71/72/87 SC, divided; juveniles black above with white cross bands (Fig. 3c); adult darker, cross bands absent on posterior part of body (Fig. 3b).

Oligodon deuvei David, Vogel & van Rooijen, 2008

Specimens examined: One juvenile specimen (IEBR A.2010.16), collected by local people on 29 May 2004. An adult male (IEBR A.2010.17), collected by P. Moler in May 2004. Another adult male (ZFMK 91226), collected by P. Moler in 2005. These specimens were found near the Headquarters of Cat Tien National Park, Dong Nai Province (near 11°27'32.9"N, 107°20'43.7"E). One adult male (ZMMU NAP-02811), collected by N. Poyarkov on 8 November 2007, in Cat Tien Village on the eastern bank of the Dong Nai River, Dong Nai Province.

Characteristic features: The morphological characters of four specimens from Cat Tien National Park agree with the description given by David et al. (2008b): SVL 283–361 mm; TaL 59.0–68.2 mm; 17 MD, 15 MD before vent; 14 maxillary teeth, the posterior two strongly enlarged; 8–9 IL; 8 SL; no presubocular; a conspicuous, pale yellow vertebral stripe, edged with two darker faint paravertebral stripes or with lines of dark dots in the paravertebral region; 4–5 markings on dorsal head surface: one transverse band across the snout, one sagital blotch between the orbits, two streaks behind the orbit, directed posteriorly downwards, and one broad arrow shaped blotch on the neck. In one specimen (ZMMU NAP-02811), three nuchal blotches are fused to one butterfly-shaped marking, and a number of small irregular dots are present on the forehead. Measurements and selected scale counts, in comparison with data of the type specimens provided by David et al. (2008b), are given in Table 1.

Colouration: In accordance with Deuve's (1985) unpublished manuscript, our specimens have a grey dorsum. The yellow vertebral stripe is broad on the neck, narrowing backwards, and edged by two dark brown paravertebral stripes. Though not mentioned by Deuve (1985) or David et al. (2008b) our specimens have a dark grey dorsolateral stripe (aligned dark brown dots in preserved specimens). Large dark blotches are present on upper tail surface in the holotype but they are lacking in our specimens. Venter and lower surface of the tail are pinkish red with numerous rectangular and subrectangular blackish-brown spots. These spots are lacking in the posterior half of the tail (Fig. 3d).

Remarks: Here we provide the first record for the Cat Tien National Park and the second collection of the species after the description of David et al. (2008b). Our data support the sexual dimorphism observed by David et al. (2008b). Due to the lower number of subcaudals and the shorter tail length, we assume that the juvenile specimen (IEBR A.2010.16) is a female. The specimens in our collection slightly differ from the type series by having a higher TL/TaL ratio in males and by having eight supralabials (this character only occurs in one of 17 specimens examined by David et al. 2008b). For the first time a colour photograph of a living specimen is provided showing the coloration of the dorsum as well as the red underside of the tail, which is used by the snake for defensive display (Fig. 3d). Our observations in the field indicate that this snake species was mostly active during twilight, but was twice observed actively foraging at day time. *O. deuvei* was found along the riverside and neighbouring rural areas. The stomach of ZMMU NAP-02811 contained

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Table 1. Measurements and selected scale counts of *Oligodon deuvei* specimens from Cat Tien National Park in comparison with the type series (for abbreviations see Material and Methods).

	Type specimens (David et al. 2008)	IEBR A.2010.17 (♂)	ZFMK 91226 (♂)	ZMMU NAP-02811 (♂)	IEBRA. 2010.16 (juv.) (♂)
TL (mm)	up to 333				
	535 (♀)	342	384.2	328.5	108.8
SVL (mm)	up to 275(♂)				
	302(♀)	283	316	271	95.1
TaL (mm)	up to 58(♂)				
	51(♀)	59	68.2	57.5	13.7
TaL/TL	(♂): 0.158–0.172				
	(♀): 0.132–0.149	0.173	0.178	0.175	0.126
VEN	(♂): 140–147				
	(♀): 147–155	148	151	144	158
SC	(♂): 36–73				
	(♀): 31–38	42	40	40	33
SL	7–8	8/8	8/8	8/8	8/8
IL	8–9	9/9	9/9	9/9	9/9

one juvenile frog (*Fejervarya limnocharis*) and two unidentified anuran tadpoles.

***Oligodon ocellatus* (Morice, 1875)**

Specimens examined: Two female specimens (ZFMK 88919–88920), collected by P. Geissler in Cat Tien National Park, Dong Nai Province. One female specimen (IEBR A.2010.54.), collected by W. Van Devender on 28 May 2004, near Bau Sau Lake, Dong Nai Province (near 11°27'32.9"N 107°20'43,7"E, 167 m a.s.l.).

Characteristic features: The morphological traits of the specimens (data given in the following order: ZFMK 88919 / ZFMK 88920 / IEBR A.2010.54) from Cat Tien National Park fit the descriptions of David et al. (2008a): SVL 405 mm / 199 mm / 209 mm; TaL 108 mm / 28.3 mm / 29.7 mm; 1 presubocular; 8 SL; 9 IL; 19 MD; 173 / 159 / 165 VEN; precloacal scale undivided; 59 / 59 / 41 SC; dorsum light brown, with 11–14 dark brown blotches, edged with black; dark brown cross bands along the dorsum; head dark brown. For colouration in life see Fig. 3e.

Remarks: The occurrence in the Cat Tien National Park, Dong Nai Province is the southernmost record of this species in Vietnam (compare with Nguyen et al. 2009).

***Xenochrophis flavipunctatus* (Hallowell, 1861)**

Specimens examined: One juvenile specimen (IEBR A.2010.46), collected by W. Van Devender in 2006, in Cat Tien National Park, Dong Nai Province. One subadult specimen (ZFMK 88914), collected by P. Geissler on 19 May 2009 at the headquarters of the Cat Tien National Park, Dong Nai Province (near 11°25'19.3"N, 107°25'42.0"E, 104 m a.s.l.).

Characteristic features: The morphological characters of the specimens (data given in the following order IEBR A.2010.46./ ZFMK 88914) fit the descriptions of Bourret (1936), Smith (1943), and Ziegler et al. (2007): SVL 206 mm / 244 mm; TaL 76 mm / 119 mm; 1 loreal; 1 preocular; 3 postoculars; 8 SL; 10 IL; 19 MD, keeled; 136 / 125 VEN; precloacal scale divided; 77 / 85 divided SC; head and dorsum grey; light band from the eye to the angle of the mouth, edged with black; parietals with a light blotch, edged with dark brown (in juveniles); lateral sides of neck yellow; flanks with a series of black blotches. For colouration in life see Fig. 3f.

DISCUSSION

In their review of the herpetofauna of the Cat Tien National Park, Nguyen & Ho (2002) listed 42 species of snakes, which is almost 21% of the 203 snake species known from Vietnam (Nguyen et al. 2009, Orlov et al. 2010, Ziegler & Nguyen 2010). These records were based on their unpublished reports and examination of voucher specimens. After reviewing the list, we regard one record as questionable. The record of "*Homalopsis fasciatus*", which is based on an unpublished report, is obviously incorrect as this taxon does not exist in current faunal works in this region (Bourret 1936, Nguyen et al. 2009). Besides nine new records based on voucher specimens, the presence of *Boiga guangxiensis* in the Cat Tien National Park was proven by a photograph taken by W. Van Devender (pers. comm.). Nguyen & Ho (2002) reported the occur-

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Table 2. List of snake species recorded from Cat Tien National Park (Dong Nai and Lam Dong provinces).

Taxon	Nguyen (1988)	Le et al. (1998)	Nguyen & Ho (2002)	This study
Typhlopidae				
Ramphotyphlops braminus (Daudin, 1803)	x		x	IEBR A.2010.51–A.2010.52 ZFMK 88925
Typhlops siamensis Günther, 1864				ZFMK 88922
Cylindrophiidae				
Cylindrophis ruffus (Laurenti, 1768)	x		x	—
Pythonidae				
Python bivittatus Kuhl, 1820	x	x	x	—
Python reticulatus (Schneider, 1801)	x	x	x	—
Xenopeltidae				
Xenopeltis unicolor Reinwardt in Boie, 1827			x	—
Colubridae				
Ahaetulla prasina (Reinhardt, 1827)	x		x	IEBR A.2010.53
Boiga cyanea (Duméril, Bibron & Duméril, 1854)			x	—
Boiga guangxiensis Wen, 1998				
Boiga multomaculata (Boie, 1827)				ZFMK 88923
Boiga siamensis Nootpand, 1971			x	—
Calamaria pavimentata Duméril, Bibron & Duméril, 1854				ZFMK 88924
Chrysopelea ornata (Shaw, 1802)	x		x	ZFMK 88905–88907
Coelognathus flavolineatus (Schlegel, 1837)				ZFMK 88898
Coelognathus radiatus (Boie, 1827)	x	x	x	—
Dendrelaphis ngansonensis (Bourret, 1935)				ZFMK 88913
Dendrelaphis pictus (Gmelin, 1789)	x		x	ZFMK 88912
Dryocalamus davisonii (Blanford, 1878)			x	ZFMK 88929–88930, 91898 IEBR A.2010.46
Gonyosoma oxycephalum (Boie, 1827)			x	—
Lycodon laoensis Günther, 1864			x	ZFMK 88928
Lycodon subcinctus Boie, 1827				IEBR A.2010.42–A.2010.43 ZFMK 91899
Oligodon cinereus (Günther, 1864)			x	ZFMK 88921
Oligodon deuvei David, Vogel & van Rooijen, 2008				IEBR A.2010.16–A.2010.17 ZFMK 91226 ZMMU NAP-02811
Oligodon fasciolatus (Günther, 1864)			x*	—
Oligodon ocellatus (Morice, 1875)				IEBR A.2010.54 ZFMK 88919–88920
Ptyas korros (Schlegel, 1837)	x	x	x	ZFMK 88915
Ptyas mucosa (Linnaeus, 1758)	x	x	x	—
Rhabdophis chrysargos (Schlegel, 1837)		x	x	IEBR A.2010.45
Rhabdophis subminiatus (Schlegel, 1837)			x	ZFMK 88908–88909
Sibynophis collaris (Gray, 1853)			x	—
Xenochrophis flavipunctatus (Hallowell, 1861)				IEBR A.2010.46, ZFMK 88914
Homalopsidae				
Enhydris bocourti (Jan, 1865)	x		x	IEBR A. 2010.55–A.2010.56 ZFMK 88926
Enhydris enhydris (Schneider, 1799)	x		x	—
Homalopsis buccata (Linnaeus, 1758)	x		x	ZFMK 88927
Pareatidae				
Pareas carinatus (Boie, 1828)			x	ZFMK 88910–88911
Pareas margaritophorus (Jan, 1866)			x	IEBR A.2010.44
Lamprophiidae (incertae sedis)				
Psammodynastes pulverulentus (Boie, 1827)			x	ZFMK 88900–88904
Elapidae				
Bungarus candidus (Linnaeus, 1758)			x	—
Bungarus fasciatus (Schneider, 1801)	x		x	—
Calliophis maculiceps (Günther, 1858)			x	IEBR A.2010.48, ZFMK 91900
Naja kaouthia Lesson, 1831			x	—
Naja siamensis Laurenti, 1768	x	x	x	—
Ophiophagus hannah (Cantor, 1836)	x	x	x	—
Viperidae				
Calloselasma rhodostoma (Kuhl, 1824)			x	—
Cryptelytrops albolabris (Gray, 1842)	x	x	x	IEBR A.2010.49 ZFMK 91897
Cryptelytrops rubeus Malhotra, Thorpe, Mrinalini & Stuart, 2011 (listed as *C. macrops* by Nguyen & Ho 2002)			x	IEBR A.2010.50 ZFMK 88916–88918
Viridovipera stejnegeri (Schmidt, 1925)			x	—

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rence of *Cryptelytrops macrops* in the Cat Tien National Park. However, Malhotra et al. (2011) recently described the Ruby-eyed Green Pitviper *Cryptelytrops rubeus* from southern Vietnam and Cambodia.The distribution of *Cryptelytrops macrops* is now restricted to Thailand, Cambodia, and Laos (Malhotra et al. 2011). Based on our specimens with the red eye, we herein confirm the presence of *Cryptelytrops rubeus* in the Cat Tien National Park. The updated checklist of 51 species of snakes of Cat Tien National Park is provided in Table 2. For the generic composition of snakes we follow Pyron et al. (2010).

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Description of a new species of the genus *Dendrelaphis* Boulenger, 1890 from Myanmar (Squamata: Serpentes: Colubridae)

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Abstract. The population systematics of the colubrid snake so far referred to as *Dendrelaphis gorei* (Wall, 1910) were investigated by carrying out a multivariate analysis of geographic variation. The results reveal the existence of two distinct and apparently disjunct phenotypes. These phenotypes are assumed to represent independent evolutionary lineages. The first lineage corresponds with *D. gorei* which inhabits the Assam Valley and adjoining Himalayan foothills. However, the name *Dendrophis gorei* Wall, 1910 is actually a junior synonym of *Dendrelaphis biloreatus* Wall, 1908. Consequently, the latter name is adopted for this lineage. The second lineage, described in this paper as a new species, inhabits the South Myanmar lowlands and neighbouring mountain chains. It is distinguished from *D. biloreatus* on the basis of its higher ventral count (203–212 versus 190–199), its undivided anal shield (divided in *D. biloreatus*) and its higher average number of anterior temporal shields (usually 2 versus usually 1).

Key words. *Dendrelaphis* sp. n., *Dendrelaphis gorei* syn. n., *Dendrelaphis biloreatus*, Myanmar, analysis of geographic variation.

INTRODUCTION

The colubrid snakes of the genus *Dendrelaphis* Boulenger, 1890 are widely distributed, ranging from Pakistan in the West to the northern and eastern coast of Australia in the East and South and to southern China in the North (Ziegler & Vogel 1999). Members of the genus *Dendrelaphis* are slender, diurnal species that are predominantly arboreal and feed mainly on lizards and amphibians.

Boulenger (1894), Wall (1921), Meise & Henning (1932), Mertens (1934) and Smith (1943) have in turn worked on the systematics of this genus. Nevertheless, their cumulative effort did not result in an unambiguous and complete taxonomy of this genus, a fact that was underlined by the recent descriptions and revalidations of several species (Vogel & Van Rooijen 2007, 2008, 2011; Van Rooijen & Vogel 2008a, 2008b, 2008c, 2009).

Dendrelaphis gorei (Wall, 1910) has been reported to occur in Northeast India and Myanmar. It is one of the least known members of its genus and is scarcely represented in museum collections. In recent years however, new material has become available through the Myanmar Herpetological Survey, a collaborative effort of the California Academy of Sciences, Smithsonian Institution and the Forest Department, Ministry of Forestry, Myanmar (e.g. Wogan et al. 2008). In this paper, we investigate the population systematics of *D. gorei* by performing a multivariate analysis of geographic variation based on morphological data. Furthermore, the name *Dendrelaphis biloreatus* Wall, 1908 is evaluated. Smith (1943) synonymized *D. biloreatus* with *D. gorei* (Wall 1910) as he could not find any differences between the two species apart from the divided loreal shield in *D. biloreatus*. However, according to the rule of priority (Art. 23, ICZN, 1999), the name *D. biloreatus* should be adopted for this species.

MATERIALS AND METHODS

Eleven museum specimens were examined for this study. In addition, data on three additional specimens were taken from Wall (1908, 1910). For each examined specimen, 23 characters including aspects of colour pattern, body proportions and scalation were recorded (Table 1). Eye-diameter and distance eye-nostril were measured with a slide calliper to the nearest 0.1 mm. These measurements were made on the left and right side and were subsequently averaged. Snout-vent length was measured to the pos-

terior margin of the anal plate by marking the length on a piece of string and subsequently measuring the position of the mark to the nearest 0.5 cm. Tail-length was measured to the nearest 0.5 cm by straightening the tail against a ruler. The number of ventrals was counted using Dowling's method (1951). Subcaudals were counted on one side, the terminal scute was excluded. The first sublabial was defined as the scale that starts between the posterior chin shield and the infralabials and that borders the infralabials (see Peters 1964, fig. 7). The last infralabial was defined as the infralabial still covered completely by the last supralabial. The posterior most temporal scales were defined as the scales of which more than half of the area lies in front of an imaginary line that runs from the apex of the last supralabial to the posterolateral corner of the parietal.

Geographic coordinates were taken directly from the field notes or were obtained by translating locations to coordinates. Relevant variables were included in a Principal Components Analysis (PCA, e.g. Cramer 2003) in order to reduce the dimensions of the dataset. The resulting PCA-scores were then plotted against longitude and latitude in order to visualize the pattern of geographic variation. Confirmatory geographic analyses of the PCA-score were carried out by Analysis of Covariance (ANCOVA; Maxwell & Delaney 1990; Norusis & SPSS 1993) using longitude and latitude as covariates and phenotype as factor. Normality of the PC-scores was first tested by means of Kolmogorov-Smirnov tests.

All statistical analyses were carried out with the software SPSS (2006; SPSS for Windows. Release 14.0.2. Chicago: SPSS Inc.).

Table 1. List of morphometric, scalation and coloration characters used in this study and their abbreviations.

Abbreviation	Character
Morphometrics	
EYED	Horizontal diameter of the eye
EYEN	Distance from centre of the eye to posterior border of the nostril
TAIL	Tail-length
WSNOUT	Width of the snout measured at the position of the nostrils
LHEAD	Head-length measured from the tip of the snout to the rear of the jaw
SVL	Snout-vent length
Scalation	
VENT	Number of ventrals
SUBC	Number of subcaudals
DOR1	Number of dorsal scale rows 1 head-length behind the head
DOR2	Number of dorsal scale rows at the position of the middle ventral
DOR3	Number of dorsal scale rows 1 head-length before the tail
SUBL	Number of infralabials touched by the first sublabial (L+R)
SL1	Number of supralabials (L+R)
SL2	Number of supralabials touching the eyes (L+R)
LOR	Number of loreals (L+R)
INFR	Number of infralabials (L+R)
ATEMP	Number of anterior temporals (L+R)
TEMP	Number of temporals (L+R)
POC	Number of postoculars (L+R)
VERT	Vertebral scales smaller than (0) or larger than (1) scales of the first dorsal row
AN	Anal shield divided (0) or undivided (1)
Coloration	
TSTRIPE	Postocular stripe absent (0), rudimentary (1), present (2)
LSTRIPE	Ventrolateral stripe absent (0), present (1)

The collected data were used to carry out an analysis of geographic variation. The objective of this analysis was to enable differentiation between clinal variation and phenetic discontinuities, the latter being evidence for lineage separation (e.g. Lenk & Wüster 1999; De Queiroz 2007).

Material examined. S-037, Guwahati, Assam; BMNH 1940.3.4.24, Assam; BMNH 1940.3.4.25, Samagooting, Assam; BMNH 1946.1.10.30, Jaipur, Assam (syntype *Dendrophis gorei* Wall, 1910); CAS 208429, Myanmar, Bago Division, Bago Yoma, Sein Yay Camp, 18 51 21.636

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N, 96 10 21.324 E; CAS 211939, Myanmar, Ayeyarwady Division, vic Mwe Hauk Village (16 16 39.2 N, 94 45 32.5 E); CAS 222114-222115, Myanmar: Bago Division, Aok Twin Township, Ka Baung Reserve, Sein Ye Camp, Block 120, 18 51 16.1 N, 96 10 23.6 E; CAS 222339, Myanmar: Chin State, Min Dat Township, Min Dat Township, Nat Ma Taung National Park, 21 21 14.9 N, 93 56 08.3 E; CAS 234880, Myanmar,: Chin State, Mindat Township, Mindat District, 21 26 43.5 N, 94 00 24.0 E; CAS 244037, Myanmar, Sagaing Division, Leha and Khante township boundary, Nana Sa Laing camp, 26 07 23.1 N, 95 32 24.6 E

Museum abbreviations. BMNH: Natural History Museum, London, Great Britain. CAS: Collection of the California Academy of Sciences, USA. S: Saibal Senguptas Collection, Guwahati, Assam

RESULTS

Statistics

Visual inspection of the data suggested a striking differentiation between specimens from Assam (NE India) and Northwest Myanmar on the one hand and specimens from the remainder of Myanmar on the other hand. One phenotype was characterized by a high number of ventral counts, an undivided anal shield and usually two anterior temporal shields whereas the other was characterized by a low number of ventrals, a divided anal shield and usually one anterior temporal shield. These characters were included in a PCA. The first component explained 92% of the total variance. This demonstrates that these characters covary strongly and thus form a suite of characters that sharply differentiates between the two phenotypes. The individual scores on this component were plotted

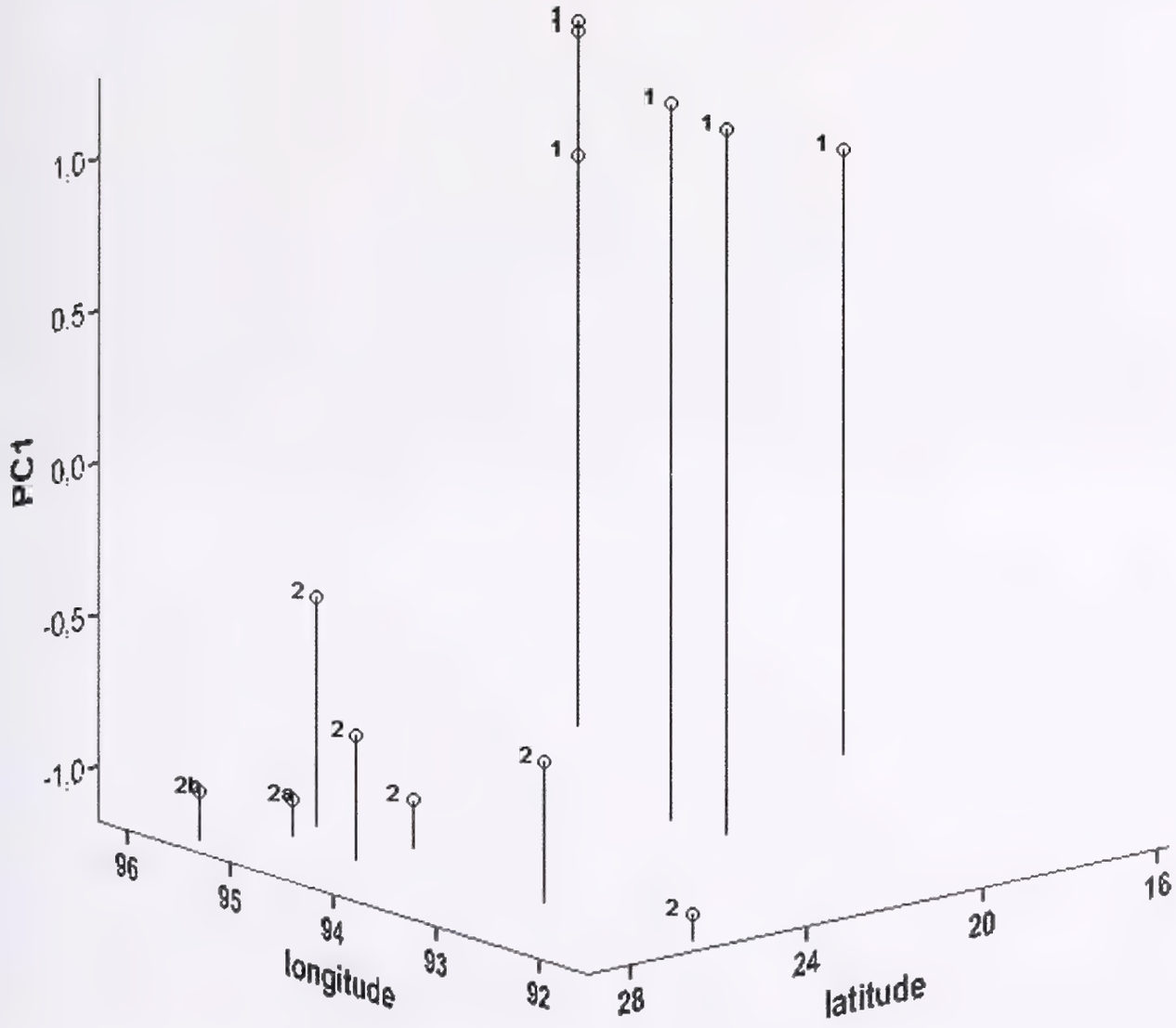

Fig. 1. PCA-scores based on a PCA of the characters VENT, AN and ATEMP against longitude and latitude. 1 Phenotype 1, 2 phenotype 2, 2b= type *D. biloreatus* Wall, 1908; 2a = syntype *D. gorei* Wall, 1910.

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against latitude and longitude to visualize the pattern of geographic variation. In figure 1, data-points corresponding with the type of *Dendrelaphis biloreatus* and one of the two syntypes of *Dendrophis gorei* are indicated for a later discussion of the appropriate nomenclature. A phenetic discontinuity is in evidence, the difference in PCA-scores between the phenotypes being highly significant (ANCOVA, df=1,11; P<0.0001). Subsequent inclusion in the model of longitude and latitude in the form of covariates demonstrated that geographic coordinates had no added explanatory power (ANCOVA, df=1,9; P=0.9 and df=1,9; P=0.4 respectively). Thus, there is no evidence of clinal variation, the transition from one phenotype to the other apparently being sudden rather than gradual.

The sudden phenetic transition represents strong evidence for lineage separation. Thus, the two distinguished phenotypes are here interpreted as representing distinct evolutionary sister-lineages. An evaluation of the characters separating the two phenotypes supports this view. First, one phenotype exhibits an undivided anal shield whereas the other has a divided anal shield. An undivided anal shield is an exceptional character in the genus *Dendrelaphis*. The only congeneric species that exhibits this character (in roughly 40% of the specimens) is *Dendrelaphis proarchos* (Wall, 1909) (Vogel & van Rooijen 2011). We examined more than 600 museum specimens of this genus, representing 24 species and subspecies. Only a single specimen (beside those identified as *D. proarchos* and the material presented in this study) was found to have an undivided anal shield. Second, the two phenotypes differ substantially in the number of ventral scales, the difference being 19 on average (211 in phenotype 1, 192 in phenotype 2). This is a relatively large difference when compared to established interspecific differences. For instance, the difference in ventral count between *D. formosus* on the one hand and *D. kopsteini* and *D. cyanochloris* on the other hand is 5 and 19 respectively (Vogel & Van Rooijen 2007). The difference between *D. haasi* and *D. pictus*, *D. pictus andamanensis*, *D. humayuni*, *D. tristis* is 3, 20, 10 and 14 respectively (Van Rooijen & Vogel, 2008a). Finally, the difference between *D. chairecacos* on the one hand and *D. tristis* and *D. schokari* on the other is 10 and 12 respectively (Van Rooijen & Vogel 2009). The third difference between the two phenotypes is the number of anterior temporal scales. Phenotype 1 usually has two anterior temporal scales whereas phenotype 2 has a single anterior temporal in the majority of cases. This character alone already leads to a correct identification in 85% of the cases.

Table 2. Comparison between the type of *Dendrelaphis biloreatus* and six specimens of the species so far referred to as *Dendrelaphis gorei*.

	type *Dendrelaphis biloreatus*	*Dendrelaphis gorei* (n=6)
Ventrals	192	190–199
Subcaudals	147	144–152
Relative tail-length	0.34	0.34–0.35
Supralabials	9	8–9
Supralabials touching the eye	3	2–3
Anterior temporals	1	1–2
Total number of temporals	8	7–12
Poctoculars	2	1–2
Loreals	2	1
Dorsal rows at midbody	13	13
Divided anal shield	yes	yes
Faint ventrolateral line, not bordered by black lines	yes	yes
Postocular stripe that covers the whole temporal region and extends onto the neck	yes	yes
Total length	70.0	53.5–90.0
vertebrals strongly enlarged	yes	yes
Ground color brown	yes	yes
Maxillary teeth	21	20 (n=1)

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Fig. 2. *Dendrelaphis walli* sp. n., holotype (CAS 234880).

Nomenclature

Two available names, *Dendrophis gorei* Wall, 1910 and *Dendrelaphis biloreatus* Wall, 1908 are relevant in the context of this study. In figure 1, data pertaining to a syntype of *D. gorei* and the type of *D. biloreatus* are indicated. It is evident that neither of these types represents phenotype 1 (South Myanmar and neighbouring mountain chains). Thus, we here describe phenotype 1 as a new species. Phenotype 2 (Assam and Northwest Myanmar) is currently known as *D. gorei* (Wall, 1910), but we here adopt the older name *Dendrelaphis biloreatus* Wall, 1908 to represent this lineage. *Dendrelaphis biloreatus* was described by Wall on the basis of a single specimen. Smith (1943) synonymized *D. biloreatus* with *D. gorei* as he could not find any difference between the two species apart from the divided loreal shield in *D. biloreatus*. In table 2, a more detailed comparison is provided between the morphological characteristics of the type of *D. biloreatus* and six specimens of *D. gorei*. With the exception of the loreal shield, the values pertaining to the type of *D. biloreatus* all fall within the range of *D. gorei*. Thus, the results agree with Smith's view that the type of *D. biloreatus* represents an exceptional specimen with a split loreal shield within *D. gorei*. In the context of a revision of the taxonomy of this genus, the authors have come across several specimens of *Dendrelaphis* with either a double or an absent loreal shield. Furthermore *D. biloreatus* has a rather long and slender postnasal scale which looks like second loreal shield at the first glance. So indirectly the name makes some sense. Consequently, the two names indeed refer to the same species. According to the rule of priority (ICZN, 1999, art. 23.1), the name *Dendrelaphis biloreatus* should actually be adopted for this species.

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Table 3. Morphological and coloration characters of the types of *Dendrelaphis walli* sp. n.

Collection N°	CAS 234880	CAS 208429	CAS 211939	CAS 222114	CAS 222339	CAS 222115
status	holotype	paratype	paratype	paratype	paratype	paratype
Sex	f	–	m	m	m	f
Snout-vent length (cm)	48.5	–	49.0	54.5	61.5	59.5
Tail-length (cm)	22.5	–	25.5	29.5	29.0	31.0
Head-length (mm)	13.5	–	15.5	15.5	17.0	17.0
Eye-diameter (mm)	3.1	–	3.5	3.5	3.9	3.5
Snout-width	2.8	–	3.2	3.4	3.7	3.3
Ventrals	213	211	203	210	212	212
Subcaudals	145	–	148	163	147	159
Dorsal formula	13-13-11	–	13-13-11	13-13-11	13-13-9	13-13-11
Temporal formula	22212/2122	222/222	222/212	212/112	2212/222	222/212
Supralabials	8/8	8/8	8/8	8/8	8/8	8/8
Supralabials touching the eye	4,5/4,5	4,5/4,5	4,5/4,5	4,5/4,5	4,5/4,5	4,5/4,5
Infralabials	10/10	–	10/10	?/9	10/10	11/10
Infralabials touched by first sublabial	6,7/6,7	–	6,7/6,7	6,7/5,6	6,7/6,7	6,7/6,7
Loreals	1/1	1/1	1/1	1/1	1/1	1/1
Postoculars	2/2	3/3	2/2	2/2	2/2	2/2
Number of scales bordering the parietal scales	4	–	5	5	6	5
Vertebrals larger than dorsals of the first row	yes	–	yes	yes	yes	yes
Anal shield entire	yes	yes	yes	yes	yes	yes
Light ventrolateral stripe which is faint and is not bordered by black lines	yes	–	yes	yes	yes	yes
Postocular stripe broad, covering the whole temporal region and extending onto the neck	yes	–	yes	yes	yes	yes

Taxonomy

***Dendrelaphis walli* sp. n.** (Fig. 2)
Dendrelaphis gorei (Wall, 1921) (part.)

Holotype. CAS 234880, adult female from Myanmar (Chin State: Mindat township, Mindat District, 21 26 43.5 N, 94 00 24.0 E, 3582 ft), collected by A.K. Shein and T. Nyo, 23 Aug 2005.

Paratypes. CAS 208429, CAS 211939, CAS 222114–222115, CAS 222339.

Diagnosis. A species of *Dendrelaphis*, characterized by the combination of: 1) 13 dorsal scale rows at midbody; 2) strongly enlarged vertebral scales; 3) 203–213 ventrals; 4) 145–163 subcaudals; 5) 8 supralabials; 6) supralabials 4 and 5 bordering the eye; 7) 2 anterior temporals in the majority of specimens; 8) a short sublabial that touches 2 infralabials; 9) an undivided anal shield; 10) a black postocular stripe that covers the majority of the temporal region and extends onto the neck; 11) black, oblique bars on the neck region; 12) a pale ventrolateral line, not bordered by black lines.

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Table 4. Diagnostic differences between *Dendrelaphis walli* sp. n. and *Dendrelaphis biloreatus* Wall, 1908.

	Dendrelaphis walli n. sp. (n=7)	*Dendrelaphis biloreatus* (n=7)
Ventrals	211 (203–213)	192 (190–199)
Anterior temporals	usually 2 (92% of specimens)	usually 1 (86% of specimens)
anal shield	entire	divided

Description of the holotype. Adult female; body very slender; snout-vent length 48.5 cm; tail-length 22.5 cm;head distinct from neck; head-length 13.5 mm; snout-width 2.8 mm; pupil round; eye-diameter 3.1 mm; distance eye-nostril 3.1 mm; 213 ventrals; 145 subcaudals; dorsal scales in 13-13-11 rows; 8 supralabials, 4th and 5th border the eye; 10 infralabials, infralabials 1–5 touch the first chinshield, infralabials 5 and 6 touch the second chinshield; 1 preocular; 2 postoculars; 1 loreal; temporal formula 2:2:2:1:2 (L), 2:1:2:2 (R); first sublabial touches infralabials 6 and 7; vertebrals strongly enlarged, with straight posterior margin, width of the vertebral scale at the position of the middle ventral scale 2.4 mm; anal entire; parietal scales bordered posteriorly by 4 scales; ground color brownish; supralabials and throat white; some black spots on supralabials 2–4, the loreal and the preocular; a black postocular stripe starts behind the eye, covers the majority of the temporal region, and extends onto the neck where it breaks up into narrow, black oblique bars which fade away further posteriorly; a faint ventrolateral line is present, covering the first dorsal row and lower half of the second dorsal row; the ventrolateral line is not bordered by black lines; belly whitish.

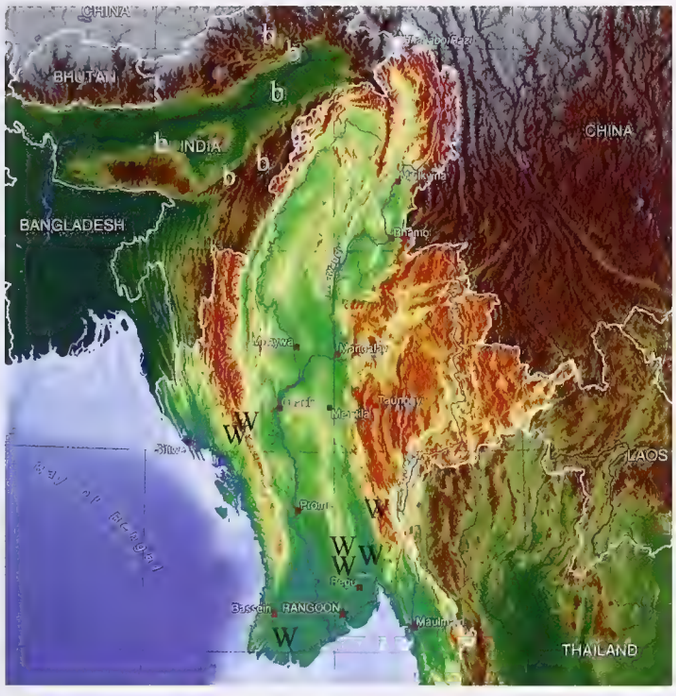

Fig. 3. Currently known distribution of *D. biloreatus* (white b) and *D. walli* sp. n. (black W).

Variation. Table 3 provides data regarding the types of *D. walli* sp. n.

Comparison with congeneric species. *Dendrelaphis walli* sp. n. differs from all congeners, except *Dendrelaphis biloreatus*, *Dendrelaphis caudolineatus* and *Dendrelaphis caudolineolatus*, by its dorsal formula of 13-13-11/9. It differs from *Dendrelaphis caudolineatus* in its strongly enlarged vertebral scales (not enlarged in *D. caudolineatus*), its much more slender body (stout in *D. caudolineatus*), its undivided anal shield, the number of supralabials (9 vs. 8 in *D. walli* sp. n.) and in its coloration. It differs from *Dendrelaphis caudolineolatus* in the number of ventral scales (149–175 vs. 203–213 in *D. walli* sp. n.) and subcaudal scales (111–129 vs. 145–163 in *D. walli* sp. n.) and its undivided anal shield. Differences between *D. walli* sp. n. and *D. biloreatus* are given in Table 4.

Sexual dimorphism. Females have a wider snout than males (ANCOVA, df=1,5, P=0.004). In addition, there is some evidence that females have a larger eye than males (ANCOVA, df=1,5, P=0.08). No evidence of other sexual dimorphisms was found though this may be due to lack of statistical power (e.g. Streiner 1990).

Distribution. According to currently known locality records, *D. biloreatus* inhabits the Assam Valley and adjoining Himalayan foothills whereas *D. walli* sp. n. inhabits the South Myanmar lowlands and neighbouring mountain chains. Thus, the two species appear to exhibit a disjunct distribution (figure 3). However, this may be due to collecting gaps. In reality, one or both of these species may inhabit the intermediate area. On the other hand, the Myanmar Herpetological Survey did collect in the central and northern parts of Myanmar, which did not yield a specimen of either species, with the exception of one *D. biloreatus* (CAS 244037) near the border with Assam, within the known range of this species. If these species indeed occur allopatrically, the central dry zone of Myanmar and adjoining mountain ranges may be the geographic barrier that separates these species and that may have enabled the independent evolution of the two.

Etymology. This species is dedicated to Major Frank Wall (1868–1950), in recognition of his outstanding work on the genus *Dendrelaphis*.

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Acknowledgements. We thank J. V. Vindum (CAS, San Francisco, USA), C. J. McCarthy (BMNH, London, United Kingdom), R. Vonk and H. Praagman (ZMA, Amsterdam, The Netherlands), Saibal Sengupta and Jayaditya Purkayastha (Indian collections) for letting us examine preserved specimens.

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Studies on African *Agama* IX. New insights into *Agama finchi* Böhme et al., 2005 (Sauria: Agamidae), with the description of a new subspecies

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Abstract. We present new information on the distribution and morphology of *Agama finchi* from eastern Africa. For the first time, material from three different populations (including the type locality) was available and the question of a possible subspecies in Uganda was positively answered. Based on the distribution pattern of *Agama* species groups, a general distribution pattern is discussed.

Key words. Reptilia, Sauria, Agamidae, *Agama finchi*, *Agama finchi* ssp. n., Africa, Kenya, Uganda, DR Congo, Ethiopia.

INTRODUCTION

Cursorily, the taxonomy and relationships between eastern African *Agama* species were thought to be well known, but after intensive research on these species, it became obvious that species limits were underestimated and several taxa were described, revalidated or regarded as synonyms (Böhme et al. 2005; Wagner 2007; Wagner et al. 2008a, 2008b; Wagner 2010). Most *Agama* species occurring in eastern Africa seem to be part of a monophyletic group (Wagner et al. unpubl. data). However, the only member of the *Agama agama* species group occurring in eastern Africa is still *A. finchi* (Leaché et al. 2009). This species was described by Böhme et al. (2005) from Malaba in western Kenya close to the Ugandan border. These authors also mentioned a population from Murchison Falls in Uganda, but specimens from this population were only known from photographs. They differed from topotypical *Agama finchi* in the colouration of the forelimbs and until recently, it was not possible to confirm these photographs with voucher specimens. Additionally, further information given by Böhme et. al. (2005) show the occurrence of *A. finchi* at the 'Yale River in Uganda', but it was not possible to trace this locality. Probably the locality refers to the western Kenyan Yala River, which was in the 'Uganda' province of East Africa before 1926 (pers. comm. Stephen Spawls, 25.I.2011).

A. finchi is a small lizard and is characterized by its bicoloured red and black tails, scarlet-red heads and forelimbs and the velvet-black bodies of adult males. The throat colouration is uniform pale reddish, with a pattern of longitudinal dark reddish lines. The females are different in colouration from other *Agama* species as they possess a uniform brown body with reddish to yellow dorsolateral bands. In both sexes, a white to yellowish supralabial line is usually obvious. Nevertheless, differences in colouration between the specimens from Uganda and topotypical *A. finchi* are obvious, since the former possess body-like coloured forelimbs. However, without voucher specimens, it was so far not possible to assess the status of this population.

Currently, only few *Agama* species are known from Uganda. *Agama lionotus elgonis* Lönnberg, 1922 is known to occur in the Mt. Elgon region, and most probably *Agama finchi*, described from an area close to the border to Uganda, should occur there. Spawls et al. (2002) also mentioned a wide distribution of *Agama agama* in Uganda, but these records should be referred to *Agama lionotus* since *A. a. agama* is restricted to Central Africa (Wagner et al. 2009).

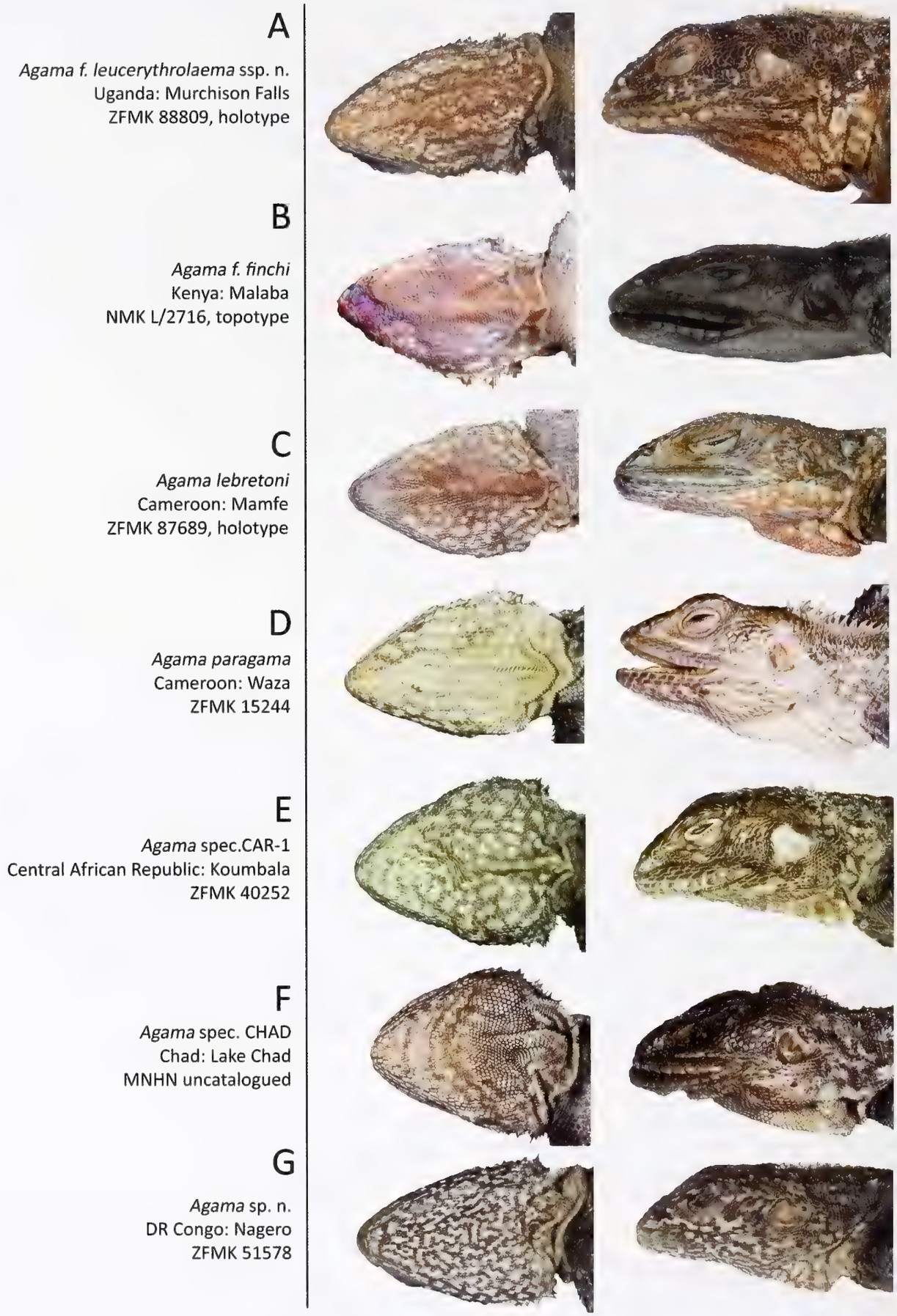

Fig. 1. Throat and left head side of male *Agama* species.

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Since the description of *A. finchi,* specimens from Uganda became available and it was possible to recognize the species from other countries by images and specimens. Therefore, the aim of this publication is to summarize and discuss the distribution of *A. finchi* and to assess the status of the populations possessing body-like coloured forelimbs.

MATERIAL AND METHODS

Material and morphological sampling. 21 specimens of *Agama finchi*, including type material, were examined. Specimens from collections of the following institutions (Institutional abbreviations in parenthesis) were used: Muséum d'histoire naturelle, Genève (MHNG); National Museums of Kenya (NMK); Zoologisches Forschungsmuseum Alexander Koenig, Bonn (ZFMK). Type material of the new species is deposited in the Zoologisches Forschungsmuseum A. Koenig, Bonn.

For each specimen, external characters were recorded: snout-vent-length (SVL), length of tail (TL), head width between the anterior margins of the ear openings (HW), head length from the tip of the snout to the anterior margin of the ear opening on the left side (HL), head height at the highest point of the head (HH), number of scales beneath the 4th toe on the left side (SD), number of scales around mid-body (MBS), number of scales between gular- and inguinal fold (V; ventrals), and the number of precloacal pores (PP). Measurements were taken with a dial calliper to the nearest 0.1 mm. Measurements and scale counts were done according to Grandison (1968) and Moody & Böhme (1984). Colour patterns in living specimens were described using field notes and life photographs.

Material examined. *Agama f. finchi* Kenya. Malaba: ZFMK 82091–82094, NMK L/2533/3, L/2534/1,3,6. *Agama f.* ssp. n. Ethiopia. Gambela: ZFMK 8709–8711, 66271. Uganda. Murchison Falls: ZFMK 88808–814, 88829. *Agama lebretoni*. Cameroon. Douala, Foyer du Marin: MHNG 2713.31; Fako (Mt. Cameroon), Limbe (Victoria): ZFMK 18891–894; Korup, Mundemba: ZFMK 61243; Magba: ZFMK 51686, 54906–907; Makum: ZMB 55709, 37061; Mamfe: ZFMK 87694–699, 87700; Mamfe, Mukwecha, Amebisu: ZFMK 87694–699; Metchum, Wum: ZFMK 15194–15200; Mt. Nlonako, Nguengue: ZFMK 69017, Rumpi Hills, Mofako Balue: MHNG 2713.29; Rumpi Hills, Big Massaka: MHNG 2713.30, 2713.32. Equatorial Guinea. Bioko Island, San Carlos: ZFMK 9353–359. Gabon. Fougamou: ZFMK 73239–245; Ngouassa: IRSNB 15686–687. *Agama paragama*. Cameroon. Logone et Chari, Waza: ZFMK 15242–256. Niger. Agadez: ZFMK 36599; Tessaoua: ZFMK 33749–750. *Agama* cf. *paragama*. Cameroon. Benoué, Boki: ZFMK 15227–241. *Agama* cf. *sylvanus*. Cameroon. Benoué: ZFMK 33751–754. *Agama* spec. | CAR-1. Central African Republic. Koumbala: ZFMK 40251–260. *Agama* spec. | CAR-2. Mélé: ZFMK 33766; Ndélé: ZFMK 33755–7654; Sibut: ZFMK 33765. *Agama* spec. | Chad Chad. Bol (near Lake Chad): 2917I–2922I (will be inventoried at the collection of the MNHN). *Agama* sp. n. Democratic Republic of the Congo. Nagero: ZFMK 51576–587; Isiro: ZFMK 51588.

RESULTS

Agama finchi leucerythrolaema ssp. n.

Holotype. ZFMK 88809, adult male from Murchison Falls, Uganda; collected by W. Freund, July 2009.

Paratypes. ZFMK 88810, adult male from Murchison Falls, Uganda; collected by W. Freund, July 2009.
ZFMK 88811, 88829, adult females from Murchison Falls, Uganda; collected by W. Freund, July 2009.
ZFMK 88808, 88812–814, juveniles from Murchison Falls, Uganda; collected by W. Freund, July 2009.

Diagnosis. This is a medium-sized lizard of the genus *Agama* (total length of adult males up to 275 mm), which is characterized by a large gular fold, a reticulated throat and a bright nuptial coloration of adult males. The throat colouration (Fig. 1A) is a reticular pattern of red lines, which thus far is only known from *A. paragama* (Fig. 1D), *A. sylvanus* (no true specimen available), *A. lebretoni* (Fig. 1C) and from recently unidentified material from the Central African Republic (formerly identified as *A. sylvanus*; Fig. 1E) Lake Chad (Fig. 1F) and DR Congo (Fig. 1G). Females are similar to those of the nominate form.

Differentiated diagnosis. *A. finchi leucerythrolaema* ssp. n. not only differs from the nominotypic form by its larger size, but additionally males of the new taxon are distinct as they possess a large gular fold, a reticulated colour pattern of the throat (for both see Fig. 1A) and body-like coloured forelimbs. Differences in pholidosis to the nominate form are only marginal but the new subspecies has a lower count of body scales (Table 1).

Because of the reticulated throat, the new subspecies is similar to some other *Agama* species. From the two Central Africa species, *A. paragama* and *A. lebretoni*, the new subspecies differs as follows:

Agama paragama possesses a yellow-whitish to chalk white head and has a higher number of scale rows around the midbody (Tab. 1). Additionally, adult males of *A.*

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Fig. 2. Male holotype (ZFMK 88809) of *Agama finchi leucerythrolaema* ssp. n. from Murchison Falls, Uganda.

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paragama show a black instead of a dark blue tail tip. Similar to the herein described new species, Grandison (1968) described the colouration of the throat of *A. paragama* as 'a dark network on a cream ground which takes the form of isolated, round, cream spots' (Fig. 1D), which is present in both sexes, and therefore similar to *A. finchi leucerythrolaema* ssp. n. as the females also have a striated throat pattern.

A. lebretoni differs from the new subspecies by having a pale vertebral band and scattered white body scales. Additionally, the average snout-vent-length in this species is larger than in the new subspecies (*A. lebretoni*: 117.8 mm; *A. f. leucerythrolaema* ssp. n.: 102.4 mm).

The new subspecies differs from the West African, *A. sylvanus*, in having a higher mid-body scale count. According to MacDonald (1981), *A. sylvanus* has 59 to 66 scale rows, whereas *A. finchi leucerythrolaema* ssp. n. has 71 to 78 rows. The same author described the pattern of the throat as 'marked with an irregular pattern of longitudinal whitish lines and (more rarely) small spots', which is similar to the herein described subspecies.

A. finchi leucerythrolaema ssp. n. is clearly dissimilar to the Central African *A. a. agama*, since the latter possesses a uniform to striated red throat, a tri-coloured tail and a yellow head. However, according to Grandison (1968), her specimens of *A. agama* from Nigeria (currently not traceable if it is *A. agama* sensu stricto or sensu lato) has 59 to 77 rows, which is similar to *A. f. leucerythrolaema* ssp. n. (71 to 78 rows).

A. finchi leucerythrolaema ssp. n. differs from other East African *Agama* species as follows:

- from *A. lionotus* in having a reticulated throat, a tri-coloured tail and a dark blue body colouration, in having lower scale counts around the midbody (*A. l. lionotus*: 67–91 | 75.4; *A. l. elgonis*: 79–87 | 81.8; *A. finchi leucerythrolaema* ssp. n.: 73.9) and a large gular fold;
- from *A. turuensis* in having a reticulated throat, a gular fold and lower count of scale rows around the midbody (*A. turuensis*: 71–85 | 77.6; *A. finchi leucerythrolaema* ssp. n.: 73.9);
- from *A. kaimosae* in having a reticulated throat, a gular fold, a blue body colouration, lower scale counts around the midbody (*A. kaimosae*: 79–82 | 80.0; *A. finchi leucerythrolaema* ssp. n.: 73.9) and a tricoloured tail;
- from *A. mwanzae* in having a reticulated throat, a gular fold, a blue body colouration, lower scale counts around the midbody (*A. mwanzae*: 67–82 | 75.2; *A. finchi leucerythrolaema* ssp. n.: 73.9) and a tri-coloured tail;
- from *A. caudospinosa* in having a reticulated throat, a gular fold, a blue body colouration, lower scale counts around the midbody (*A. caudospinosa*: 74–116 | 93.3; *A. finchi leucerythrolaema* ssp. n.: 73.9) and a tri-coloured tail;
- from *A. montana, A. mossambica* and the much smaller *A. armata* in not possessing a heterogeneous body scalation.

Description of the holotype (ZFMK 88809, Fig. 2)

Habitus stout, snout-vent length 118.2 mm, tail length 150.1 mm, head length 30.3 mm, head width 19.4 mm, head height 12.8 mm.

Large triangular nasal scale slightly above the canthus rostralis and pierced with the nostril in the posterior part, directed and supplied obliquely upwards. Between the nasal scales, a single narrow longitudinal smooth scale is visible, followed by one smooth scale, larger than the other head scales. Ten supralabial and sublabial scales are on both sides. Head scales between the eyes are smooth, directed sideward from a midline of two rows of feebly keeled scale; head scales between posterior end of the eyes and neck smooth to feebly keeled, directed forwards; head scales of the temporal region smooth to feebly keeled, not directed to one side; free anterior margins of head scales with sensory pits; supraocular scales smooth. Parietal shield large and more or less pentagonal, pineal organ visible, pierced more or less in the middle of the shield. Ear hole large, about the same size as the eye, margin being composed by spiny scales, surrounded by four tufts of more or less spiny, mucronate scales; tympanum superficial. Nuchal crest low, consisting of 13 lanceolate scales. Gular scales flat, smooth, juxtaposed and becoming smaller towards the large gular fold. Dorsal body scales strongly keeled, but becoming feebly keeled at the vertebral region, mucronate, equal in size, in 56 scales from midpoint of pectoral region to midpoint of the pelvic region. Ventral body scales smooth, slightly imbricate at their posterior margins, in 69 scales from midpoint of pectoral region to midpoint of pelvic region. There are 72 scales rows around the midbody. Ten precloacal scales stringed in one row only. Tail scales strongly keeled and mucronate. Scales on the upper side of the forelimb strongly keeled, smooth on the underside, on the upper arm scales twice as large as the dorsal body scales, becoming smaller towards the underside and the manus. 4th finger longest, digital length decreasing 3-2-5-1, subdigital lamellae keeled and mucronate. Scales on the upper side of the hindlimb strongly keeled, becoming smooth on the underside, on the upper tights slightly larger in size than the dorsal body scales, becoming larger towards the lower tights. 4th toe longest, digital length decreasing 3-2-5-1.

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Fig. 3. Living specimens from the type localities **(A)** male and **(B)** female of *Agama finchi leucerythrolaema* ssp. n. from Murchison Falls, Uganda (photos by David Modry); **(C)** male and **(D)** female of *Agama finchi finchi* from Malaba, Kenya (Photos: Brian Finch).

Colouration. (in alcohol after three months of preservation). Head and neck red with a light red vertebral band extending to the back. Limbs, body and anterior third of the tail dark blue. Tail tri-coloured, at the base dark blue, followed by red and dark blue. Belly and underside of the limbs blue, tail anterior whitish, posterior bluish. Throat and the large gular fold with a reticulated pattern of red stripes on a white background.

Colouration in life. *Males*. Head, neck and parts of the shoulders red, a broad vertebral red band extends on the back from head to about half way to hindlimbs. Body, limbs and anterior third of the tail dark blue. Tail tri-banded: dark blue (extending from the body), followed by red and dark blue at the tip (Figs 3a, 4a). Belly and underside of limbs blue; throat with a reticulate pattern of red stripes on a white background.

Females. Head yellowish brown, with fine yellow stripes and dots; stripes and dots usually extending to the shoulders. Body and tail light brownish with broad lateral yellow bands (Fig. 3b). Underside whitish, with fine dark longitudinal stripes on the throat.

Juveniles. Similar to females but with more distinct yellow dots and stripes on the head on the shoulders. Yellow lateral bands sometimes extending to the back. Underside whitish, with a fine dark reticulated pattern on the throat.

Variation. Variations in morphology are shown in the appendix and compared to other agamid species in Table 1. Colouration of males is not variable and all show the typical colour pattern of throat and forelimb.

Etymology. The new species is named after its remarkably characteristic red and white vermiculated throat as compared to the nominate form. The name is derived from the Greek words 'leukos' for white, 'erythros' for red and 'laema' for the throat.

Distribution. Beside the type localities of the two subspecies, *A. finchi* was also identified from Gambela in Ethiopia, represented by material from the collection of the Zoologisches Forschungsmuseum A. Koenig (ZFMK 8709–8711; ZFMK 66639, 66271–72). In contrast to the specimens of *A. f. finchi* from Kenya and DR Congo (see below and figs 3, 5), the adult males of this population

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Fig. 4. **(A)** Living male and **(B)** habitat of *Agama finchi leucerythrolaema* ssp. n. from Murchison Falls, Uganda (Photos: Wolfram Freund).

show body-like coloured forelimbs and therefore represent the new subspecies. The colouration of the throat is not distinguishable, because of the long preservation time. However, specimens from Gambela are similar in the average of their snout-vent-length to topotypical material of the nominal subspecies (Ethiopia: 86.2 mm | Kenya: 85.7 mm). *A. f. leucerythrolaema* ssp. n. is also cryptically mentioned in Largen & Spawls (2010). Within the species chapter on *Agama agama* (sic., as *Agama agama* in neither occurs in Ethiopia nor Eritrea), specimens from Gambela are figured (Largen & Spawls 2010, fig. 147) showing the herein described subspecies. According to Stephen Spawls (pers. comm. 07.X.2010), the western population of the former '*Agama agama*' in Ethiopia and Eritrea belongs to *A. finchi*, whereas the southern ones belong to *Agama lionotus*.

Quite recently, the new subspecies was also recorded from the Lorionotom Range, Ilemi Triangle (approx coordinates: 4°53'38.53"N, 35°31'59.44"E) by Miroslav Jirku (specimens will be inventoried in the collection of the National Museums of Kenya, Nairobi), which fills the gap between the Ethiopian and Ugandan localities.

Habitat. Specimens at Murchison Falls were collected in open grassland (Fig. 4b), sitting on old houses (Fig. 4a) and on palm trees. The habitat of the Ethiopian populations is unknown, but is likely to be similar.

Relationships. According to Wagner et al. (unpubl. data) *Agama finchi* sensu lato is differentiated in two clades. Individuals from the type locality of the nominate form are distinct in colouration of forelimbs, throat, and in body size to specimens from Uganda and Ethiopia, but there are few other morphological differences (see Appendix). Genetic analysis indicates (Wagner et al. unpubl. data) that the new taxon is closely related to *A. finchi* and both taxa are members of the *Agama agama* species group.

***Agama f. finchi*: new distribution record.** *Democratic Republic of the Congo*. The nominate species was documented by photographs from the Ituri forest (Fig. 5) where it occurs on an inselberg surrounded by rainforest is not otherwise connected to savannah areas. Ecologically, this inselberg is an arid area, as rainwater flows off immediately, and the unshaded dark rocks are heated up by sunlight during the day. Therefore, fauna and flora (with e.g. rock hyrax and aloe plants; pers. comm. Reto Kuster) of this inselberg are very different from those of the surrounding rainforest. The status of these forests as a true rainforest is supported by the occurrence of *Lepidothyris hinkeli* Wagner et al., 2009, which is a character species of equatorial rainforests (Wagner et al. 2009). As can be seen from the figures 4 C–D, the specimens are identical in colouration to the specimens from the type locality of *A. f. finchi* in western Kenya. However, the throat colouration is still unknown. The distribution of both taxa is shown in figure 6.

DISCUSSION

Preliminary genetic analyses (unpubl. data) separated *Agama finchi* sensu lato into two distinct clades: this was supported by differences in the colouration of the forelimbs of adult males. However, there are more morphological differences between the Ugandan and Kenyan populations than between the Ugandan and Ethiopian. The Ugandan population is distinct from the Kenyan population because of the reticulated throat and the much larger size of adult males. Also, the Ugandan population is larger than the Ethiopian population. Furthermore, only small series were collected from all populations, and body-sizes are probably underestimated. Because the Ethiopian specimens were preserved a long time ago, the throat colouration is not identifiable anymore.

Little information is available about the species limits within the genus *Agama*. In contrast to genetic distances in-between other *Agama* species, the distances within the *A. finchi* sensu lato populations are comparatively small.

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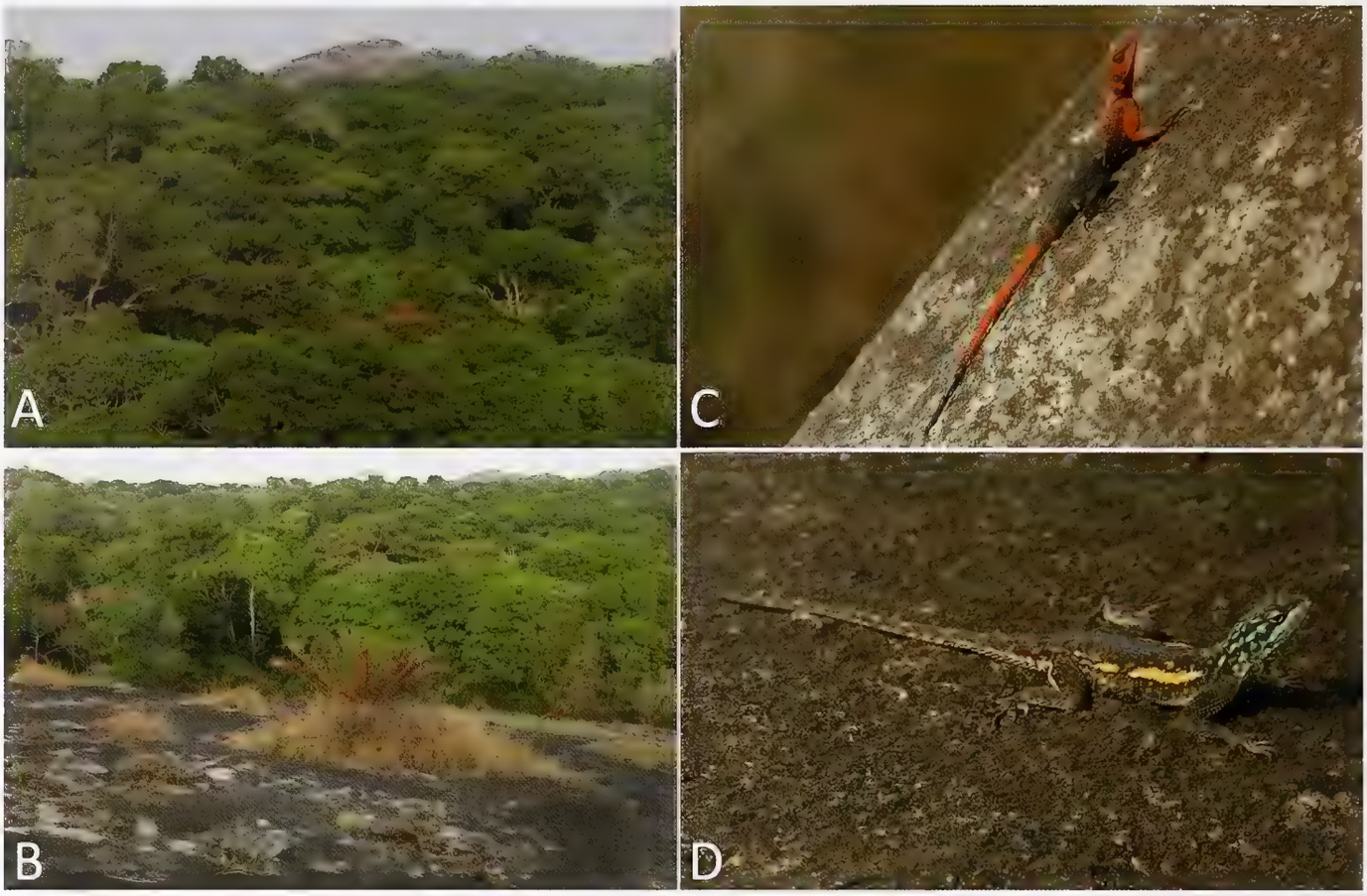

Fig. 5. *Agama f. finchi* occurrence on an inselberg within the Ituri Forest, DR Congo **(A)** View to the inselberg within the forest. **(B)** Habitat on the inselberg. **(C)** Living male of *A. f. finchi* from the same locality. **(D)** Living female of *A. f. finchi* from the same locality (Photos: Reto Kuster).

However, identification of the subspecies is possible and demonstrated by pholidosis, differences in colouration of adult males, and the colour pattern of the throat. Therefore, these populations should be recognized as a developing species and according to article 45.6 of the International Code of Zoological Nomenclature (ICZN 1999), they can be recognized as the taxonomic rank of a subspecies.

Distribution patterns and relationships are poorly known in *Agama* lizards. For decades, the genus was not in the focus of herpetological interests and most of the taxa were recognized as subspecies of *Agama agama* which, because of this original taxonomic classification, was supposed to be distributed nearly everywhere in sub-Saharan Africa. Therefore, in the older literature, *A. agama* is supposed to have a distribution range with includes nearly every Afrotropical country. Additionally, many specimens are misidentified or simply inaccurately labelled as *A. agama* in museum collections. Wagner et al. (2009) described a neotype and restricted *A. agama* s. str. to northern Cameroon. The whole *A. agama* species complex is now distributed along the southern border of the Sahara desert from western to eastern Africa and along the Atlantic coast to Namibia. Other than that, former East African subspecies of *A. agama* are now recognized as a distinct species (Böhme et al. 2005), forming the *A. lionotus* species group, which is distributed from Ethiopia through Kenya to southern Tanzania. However, the distribution patterns of the *A. agama* and *A. lionotus* species groups generally follow the theory of African arid corridors and is comparable to distributions of other reptile species groups, such as *Varanus exanthematicus*/ *albigularis* (see Wagner 2010).

The only representative of the *A. agama* species complex in eastern Africa (including Ethiopia) is *A. finchi*, as none of the other *A. agama* species complex taxa are present in Ethiopia and Uganda (pers. comm. Steven Spawls). To date, both subspecies of *A. finchi* have only been found west of the eastern branch of the East African Rift, but it is not possible to recognize this geological barrier as a distribution limit since this species is only known in four localities.

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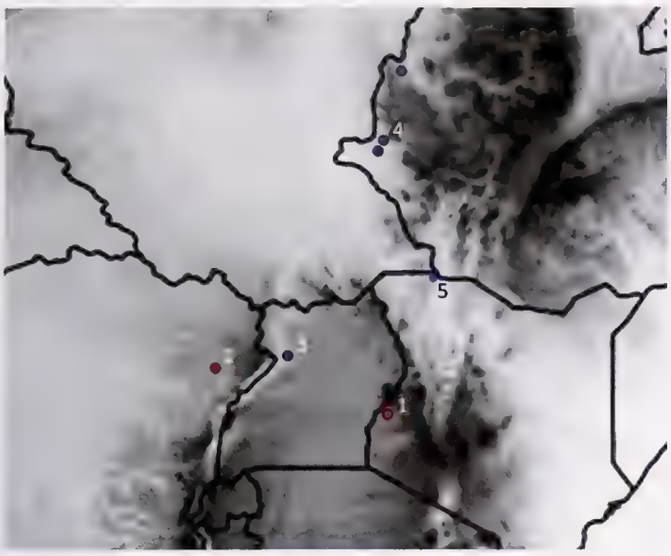

Fig. 6. Distribution of *Agama finchi*. Red dots refer to *A. f. finchi*, whereas blue dots refer to *A. f. leucerythrolaema* ssp. n. **(1)** Kenya: road to Busia near Malaba (type locality); **(2)** DR Congo (photo documention); **(3)** Uganda: Murchison Falls (type locality); **(4)** Ethiopia: Gambela. Other Ethiopian localities obtained from Largen & Spawls 2010; **(5)** Kenya: Lorionotom Range, Ilemi Triangle (approx coordinates: 4°53'38.53"N, 35°31'59.44"E).

Distribution was also influenced by the dispersal and retraction of the equatorial rain forest in the past. The population in the Ituri Forest is a relict population found on an inselberg surrounded by rainforest, usually a non-suitable habitat for *Agama* species. The status of the Guineo-Congolian rainforest is supported by the occurrence of *Lepidothyris hinkeli*, which is a character species of this forest type (Wagner et al. 2009). Therefore, the rainforests in this area seem to be relatively young as *A. finchi* was enclosed on its inselberg during an extension of the rainforest. As a result, the species must have been widely distributed within the area during the time when the rainforest last receded.

Acknowledgements. We are grateful to Reto Kuster for permission to publish his images of *Agama finchi* from DR Congo and his comments on the occurrence of this species in the DR Congo. Moreover, we are grateful to Stephen Spawls and Miroslav Jirku for their information about *A. finchi* in Ethiopia and Kenya. We thank the two referees for their comments which have improved the manuscript, and especially to Shelley Barts-Pankow who did the English review.

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APPENDIX

Taxon	No.	Locality	SVL	TL	ToL	HH	HW	HL	HL/HH	HL/HW	VEN	DOR	SaM	Fi	Toe	PCP	LBL	Sex
A. f. finchi	ZFMK 82093	Kenya: Malaba	44.0	68.3*	112.3	5.9	10.4	14.2	2.4	1.4	81	77	78	17	20	–	22.4	juv.
A. f. finchi	ZFMK 82094	Kenya: Malaba	44.6	39.3*	83.9	4.9	11.9	12.6	2.6	1.1	81	–	76	18	21	–	29,.2	juv.
A. f. finchi	NMK L/2534/6	Kenya: Malaba	52.4	77.1*	129.6	6.8	11.5	16.7	2.4	1.5	80	78	71	17	21	–	25.7	juv.
A. f. finchi	NMK L/2534/3	Kenya: Malaba	38.6	56.4*	95.0	6.3	9.3	11.2	1.8	1.2	78	78	70	18	21	–	18.4	juv.
A. f. finchi	NMK L/2534/1	Kenya: Malaba	46.0	30.4*	76.4	6.6	9.5	13.6	2.1	1.4	83	80	76	18	20	–	24.2	juv.
A. f. finchi	NMK L/2533/3	Kenya: Malaba	59.4	103.9	163.3	7.1	13.6	17.5	2.5	1.3	83	80	74	18	19	–	21.1	female
A. f. finchi	ZFMK 82091	Kenya: Malaba	78.8	123.0*	201.8	10.0	16.3	23.5	2.4	1.5	84	–	–	19	20	12	41.1	male
A. f. finchi	ZFMK 82092	Kenya: Malaba	88.6	69.8*	158.4	9.5	17.7	21.5	2.3	1.2	86	79	79	18	22	11	44.8	male
A. f. finchi	NMK L/2534/2	Kenya: Malaba	87.7	154.6*	242.3	9.8	15.7	23.2	2.4	1.5	82	79	79	18	21	12	42.8	male
A. f. leucerythrolaema	ZFMK 8710	Ethiopia: Gambela	88.2	137.5	225.7	10.7	16.8	22.6	2.1	1.3	80	79	70	19	21	–	42.8	female
A. f. leucerythrolaema	ZFMK 8711	Ethiopia: Gambela	85.4	141.1	226.5	11.2	16.4	22.2	2.0	1.4	78	61	77	20	21	–	40.4	female
A. f. leucerythrolaema	ZFMK 8709	Ethiopia: Gambela	85.5	139.9	225.4	11.3	17.0	24.5	2.2	1.4	83	60	71	19	23	13	40.3	male
A. f. leucerythrolaema	ZFMK 66271	Ethiopia: Gambela	85.6	–	–	10.1	15.9	22.9	2.3	1.4	77	60	75	19	21	12	44.5	male
A. f. leucerythrolaema	ZFMK 88809	Uganda: Murch. Falls	118.4	–	–	13.4	19.0	29.6	2.2	1.6	80	60	74	18	19	11	60.5	male
A. f. leucerythrolaema	ZFMK 88810	Uganda: Murch. Falls	116.2	162.2	278.4	14.0	20.0	28.6	2.0	1.4	81	76	75	19	22	12	60.4	male
A. f. leucerythrolaema	ZFMK 88811	Uganda: Murch. Falls	90.2	143.6	233.8	9.5	15.1	22.2	2.3	1.5	77	60	74	17	19	–	47.1	female
A. f. leucerythrolaema	ZFMK 88829	Uganda: Murch. Falls	86.9	139.8	226.7	10.1	15.9	22.5	2.2	1.4	85	63	70	16	17	–	43.1	female

SVL= snout-vent-length; TL= tail length; ToL= total length; HH= head height; HW= head width; HL= head length; VEN= Ventralia; DOR= Dorsalia; SaM= Scales around midbody; Fi= lamellas beneath left 4th finger; Toe= lamellas beneath left 4th toe; PCP= number of precloacal pores; LBL= length between limbs.

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The reptiles (Testudines, Squamata, Crocodylia) of the forested southeast of the Republic of Guinea (Guinée forestière), with a country-wide checklist

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Abstract. During several herpetological surveys in the forested southeast of the Republic of Guinea (Guinée Forestière) we recorded 64 species of reptiles (two chelonian, 16 lizard and 45 snake species as well as one crocodile species. They are presented in a commented list with documentation of the respective voucher material and with taxonomic and/or ecological information. Our record of the softshell turtle *Trionyx triunguis* is the second one for Guinea and the first for Guinée Forestière, the forest-dwelling gecko *Cnemaspis occidentalis* and the lacertid lizard *Holaspis guentheri* are likewise the respective second Guinean record of these species. The Forest Nile Monitor *Varanus ornatus* is documented for the first time in Guinea. The ground boa *Calabaria reinhardtii* is again the second country record but the only voucher specimen available for study. Moreover, we present a country-wide checklist of the reptiles of the Republic of Guinea combining literature records with our own material. It documents the occurrence of 128 reptilian species (seven chelonian, 30 lizard, 88 snake and three crocodile species). Remarkable are photographic records of a probably new, undescribed gecko species of the genus *Hemidactylus*. The skink *Trachylepis keroanensis*, formerly a synonym of *T. perroteti*, proved to be a distinct species belonging to the *T. buettneri/sudanensis* group. Finally, we provide a list of fishes found in Ziama Forest partly recovered from the stomachs of natricid snakes.

Key words. Reptilia; Republic of Guinea; Ziama Forest; country-wide checklist; list of Ziama Forest fishes.

INTRODUCTION

The Republic of Guinea belongs to the lesser known countries in West Africa (see Barnett et al. 1994 and references therein). Despite its variety of landscapes which range from dry savannas in the northeast to marshy mangrove areas in the west, and through the remarkable Fouta Djallon highlands to the forested areas in the southeast (Lamotte et al. 1962, Porembski et al. 1994, 1995), only few reptile collections have been made in this country. It is characteristic of this low level of zoological exploration that Guinea did not even "exist" in the country list of Welch's (1982) "Herpetology of Africa"! The only region where comparatively much work has been done, is the Mt. Nimba range in the extreme southeast where Guinea, Liberia and Ivory Coast meet (in part Villiers 1950, Angel et al. 1954 a,b, Lamotte 1983 for a summary, and Ineich 2003 for a recent summary including also the Ivorian and Liberian parts of this important mountain range). Whereas the amphibian fauna of Guinea received considerable attention in recent years (Rödel & Bangoura 2004a; Rödel et al. 2004, 2009, 2010; Hillers et al. 2006, 2008 a, b, c, plus many so far unpublished surveys and data), the reptiles of this country remained poorly known. Among the few sources reporting (at least partly) reptilian voucher material from Guinea exceeding the Mt. Nimba range are the papers by Mocquard (1908), Klaptocz (1913), Chabanaud (1916, 1917, 1918, 1920, 1921), Parker (1939), Villiers (1950), Grandison (1956), Condamin (1959), and Greenbaum & Carr (2005).

In October 1993, the first author (WB) had the opportunity to visit the Republic of Guinea relatively shortly after major political changes in the country enabling him to work as the first herpetologist in Guinea again, after the French workers in the colonial 1950-ies. He was invited by Dr. Wilfried Bützler as a so-called short-time expert to do a survey of amphibians and reptiles within a project of PROGERFOR (=Projet de Gestation des Ressources Forestières), Conakry, in the two southeastern rain forests

Forêt de Ziama and Forêt de Diécké. During this mission, also the Nimba Mts. were briefly visited. An itinerary can be found in the project report by Böhme (1994 a). So far, only few aspects of this mission have been published, viz. accounts on some remarkable frogs and skinks collected during the stay (Böhme 1994 b, c), including a skink which proved to be new to science (Böhme et al. 2000). Moreover, a study of the speciose snake community found in Ziama forest was published (Böhme 2000), containing several new country records. In addition, some more specimens and important voucher photographs of reptiles were subsequently provided by W. Bützler and his mammalogical colleague Dr. Henning Vierhaus, Soest. All these materials are deposited in the Zoologisches Forschungsmuseum A. Koenig in Bonn (ZFMK). A few further specimens were traced in the Zoological Museum of the University of Copenhagen (ZMUC) which had been collected and sent to Denmark in the 1950-ies by the Danish zoologist/entomologist Herold Olsen who was a resident of N'Zérékoré, SE Guinea (see Böhme 1994 b). He had kept there, in his "Centre Entomologique" in N'Zérékoré also some herpetological specimens which were guarded, after his death, along with his other collections, by two Guinean women formerly employed by him, still in 1993 (see Böhme 1994 b).

In 2003, the second author (MOR) started visiting Guinea, and carried out herpetological surveys with a main focus on amphibians in several southeastern forested areas (Forêt de Diécké, Mt. Béro, Forêt de Déré, Pic de Fon – Simandou Range, Mt. Nimba: see Rödel et al. 2004, Rödel & Bangoura 2004a, b, 2006). The third author (CB) surveyed amphibians on Mt. Nimba (2007), Pic de Fon and Mt. Tétini (2008) and the Fouta Djallon and Ziama forest (2010). The amphibian collections have partly been published (Rödel et al. 2004 and see above), while some reptile specimens which were also collected (see Rödel & Bangoura 2004b, 2006) and donated to ZFMK and the Museum für Naturkunde Berlin (ZMB), plus records of non-collected reptile specimens (photo records) are also included in the present paper.

Apart from the mostly silvicolous reptile fauna from SE Guinea, some specimens were found or observed between Conakry and Macenta by Wilfried Bützler, Henning Vierhaus and Wolfgang Böhme. These were *Hemidactylus* sp. (nov.?) from Coyah (photographic voucher see Figs 27–28); *Bitis arietans* between Kissidougou and Guéckédou: photographic voucher; *Crotaphopeltis hotamboeia* (ZFMK 54897) and *Psammophis* cf. *phillipsi* (ZFMK 56137) from Kissidougou; *Toxicodryas pulverulentus* from 25 km southeast of Guéckédou (ZFMK 56136).

Museum Koenig had also received a small number of specimens collected in winter 1996/97 by G. Nikolaus in

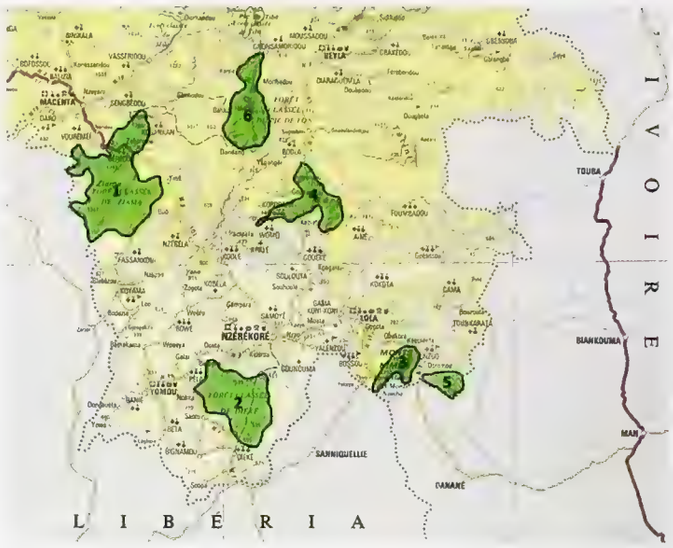

Fig. 1. Map of SE Guinea (Guinée Forestière) with the forest regions surveyed: **1.** Ziama Forest, **2.** Diécké Forest, **3.** Mt. Nimba, **4.** Mt. Béro, **5.** Déré Forest, **6.** Pic de Fon (map: P. Wagner).

the Haut Niger National Park. These specimens, including the first record of the black mamba for Guinea, were left by us for publication to Eli Greenbaum to complement his and J.L. Carr's paper on the herpetofauna of this park (see Greenbaum & Carr 2005). They are summarized here

Fig. 2. Village of Sérédou, Ziama Forest, with forested slopes in background (Photo: W. Böhme).

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Fig. 3. "Antenna hill" at Sérédou, submontane forest with the tree fern *Cyathea manniana* (Photo: W. Böhme).

for completeness' sake: *Agama agama* (ZFMK 64473–479), *Chamaeleo gracilis* (ZFMK 64489), *Varanus exanthematicus* (ZFMK 64471: head only), *V. niloticus* (ZFMK 66470), *Crotaphopeltis hotamboeia* (ZFMK 64467–468), *Grayia smithii* (ZFMK 64465–466), *Philothamnus irregularis* (ZFMK 64469), *Psammophis elegans* (ZFMK 64462–464), *Dendroaspis polylepis* (ZFMK 64459–460), *Elapsoidea semiannulata* (ZFMK 64461), and *Bitis arietans* (ZFMK 64472).

Fig. 4. Inundated lowland forest at Malweta village, Ziama Forest (Photo: W. Böhme).

Some more single specimens from near Kindia had been donated to ZFMK also by Dr. Guy Kremer, Luxembourg: *Chamaeleo gracilis* (ZFMK 87583–584), *C. senegalensis* (ZFMK 87581–582). Particularly remarkably: Sébastien Trape, Dakar, kindly donated a specimen of the rare *Agama insularis* from the Los islands to ZFMK where it has been catalogued under ZFMK 88247.

Within forested SE Guinea (Fig. 1), the focus of this paper is on Ziama Forest which turned out to house a particularly speciose snake community (42 species: see Böhme 2000), at least in regard of the short periods spend for collecting. Ziama Forest is a hilly, forested area (ca. 1300 km^2, up to ca. 1600 m a.s.l., with about 70.500 ha dense forest: ATLANTA Consult 1988) ranging from Macenta in the north to N'Zébéla in the south, and encompassing the small town Sérédou (Fig. 2) with its so-called "Mont d'antenne" (on which the local wireless mast is located) (Fig. 3) and several villages: Balassou a few km in the north, Malweta in the south (characterized by swampy forest: Fig. 4) and Souzunzou in the west of Sérédou. Primary forest is best preserved on slopes (Fig. 5). Moreover, Diécké Forest (700 km^2) and the western slope of Mt. Nimba (Fig. 6) were visited during the mission of WB in Oct. 1993.

Further Guinean sites where surveyed with a main emphasis on amphibians. From 27 November to 6 December 2002, in autumn 2004 and in September 2008 we surveyed the Simandou Mountain Range, which extends for 100 km from Komodou in the north to Kouankan in the south. The altitudinal range is about 600 m with the Pic de Fon at the southern part being the highest peak (1,656 m a.s.l.: Fig. 7). Approximately 25,600 ha of this forest were protec-

Fig. 5. Ziama Forest near Sérédou: reforestation of fire-destroyed foreground with *Terminalia* sp., slopes in the background still with primary forest (Photo: W. Böhme).

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Fig. 6. Mt. Nimba, at 1750 m (Photo: W. Böhme).

ted in 1953, but larger parts are currently explorated for iron ore. The Simandou range is in the transition between the forest and savanna zones, offering a wide range of different habitat types. Especially the rain and montane gallery and ravine forest on the western slopes range far more North than anywhere else in West Africa (for more details see Rödel & Bangoura 2004a, b and literature cited therein). Three other forest sites were surveyed in November/December 2003: The Diécké Classified Forest, situated about 25 km south of N'Zérékoré, comprises an area of 59,143 ha, with a mean altitude of 400–500 m a.s.l. The reserve comprises (almost) primary as well as secondary and highly degraded rainforest (for more details see Rödel et al. 2004). Currently it is under mining prospection activities. The Mont Béro Classified Forest (26,850 ha) is situated at the northern limit of the rainforest zone, 56 km north of N'Zérékoré, 52 km south of Beyla and 40 km west of Lola. Its highest elevation is 1,210 m a.s.l. The dominant habitat types are semi-evergreen forest (Fig. 8) and savanna (Rödel et al. 2004). The Déré Classified Forest is situated at the eastern base of Monts Nimba and directly borders Ivory Coast. It comprises lowlands and hillsides (highest peak Mont Tiéton, 740 m a.s.l.). Originally the vegetation consisted of evergreen rainforest, but most of the reserve is now in a very degraded state. From 22 April to 12 Mai 2005 we surveyed several sites in the Préfecture de Boké in north-west Guinea: Sarabaya (Rio Kapatchez), Kamsar et Boulléré. The survey focused on the (few) remaining forested sites and humid zones (for details see Hillers et al. 2006, 2008c). CB surveyed further sites in southeastern Guinea incl. Simandou and Mt. Nimba, the Ziama forest, and several sites in the Fouta Djallon.

Fig. 7. Pic de Fon showing rain forest remnants (Photo: M.-O. Rödel).

Fig. 8. Mt. Béro with one of its mountain creeks (Photo: M.-O. Rödel).

This paper aims to make the faunistic and autecological data of our material available, and to summarize the current state of knowledge of the reptile fauna of the Republic of Guinea in the form of a checklist.

Fig. 9. *Kinixys erosa* from Diécké Forest (Photo: M.-O. Rödel).

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COMMENTED SPECIES LIST

Testudines
Testudinidae

Three species of tortoises, all of the genus *Kinixys*, are known from Guinea. While *K. belliana* is known from the drier north (Chabanaud 1921, Greenbaum & Carr 2005), the forest species *K. homeana* has been recorded by Chabanaud (1921) from N'Zébéla just south of Ziama Forest. The third species is likewise silvicolous:

Kinixys erosa (Schweigger, 1812)

Material examined: voucher photographs only.

Remarks: Several photographs by W. Bützler, document the occurrence of this species in Ziama Forest near Sérédou where it does not seem to be rare: a hatchling from December 1991, and two adults in March 1995. MOR found it in Diécké Forest (Fig. 9). Villiers (1958) gave only the imprecise information "depuis Sierra Leone jusq'au Nord de l'Angola" et à Uganda. Cité aussi de Gambie (?)". The latter questionable record is cited as a fact by Wermuth & Mertens (1961): "Von Gambia südwärts bis Belgisch-Congo". In contrast, Pritchard (1979) listed the countries with reliable records separately: in West Africa only Ivory Coast, Liberia and Sierra Leone. Ineich (2003), however, recorded two specimens from the Guinean part of Mt. Nimba, thus proving the existence of *K. erosa* in this country. Our photographic vouchers provided the second Guinean locality and the first site outside of Mt. Nimba. However, recent work revealed this tortoise to be more broadly distributed in Guinée forestière, viz. also in Déré and Diécké Forests as well as on Mt. Béro (Rödel & Bangoura 2006).

Fig. 10. *Trionyx triunguis* from Ziama Forest (Photo: W. Bützler).

Trionychidae

Trionyx triunguis (Forsskal, 1775)

Material examined: voucher photographs only.

Remarks: Again, a photograph by W. Bützler (Fig. 10) documents the occurrence of this softshelled turtle in Ziama Forest. In his monograph on this species, Gramentz (2005) enumerates the distributional records for each country from which *T. triunguis* is known, Guinea not being among them. However, Guinea Bissau. Sierra Leone and Liberia are (see also Loveridge & Williams 1957) so that the presence in Guinea is not unexpected. The first documented record from Guinea is by Greenbaum & Carr (2005) who found it in the Parc National Haut Niger, our record from Ziama representing the second for the country and the first for Guinée forestière.

Squamata
Agamidae

There are four nominal species of the genus *Agama* known from Guinea: *Agama agama* (Linnaeus, 1758), *A. cristata* Mocquard, 1905, *A. insularis* Chabanaud, 1918, and *A. sankaranica* Chabanaud, 1918. While *Agama agama* is a species complex common but nonetheless taxonomically problematic (see below), *A. cristata* (Pays Sankaran) and *A. insularis* (Los Islands off Conakry, Kindia) are geographically very restricted. Morphologically, *A. boulengeri* from Mali and Mauritania seems to be their sister taxon (Wagner et al. 2009). We want to stress here that we disagree with Barabanov (2008) who proposed a new name for *A. cristata* claiming its preoccupation by *A. cristata* Merrem, 1820 (= *Corythophanes cristatus*, Iguania: Corythophanidae) as *A. maria*. Our argumentation is found in Wagner & Böhme (2009). *A. sankaranika*, finally, is known from several localities in Guinea (Moussaia/Pays Sankaran, Kankan, Kérouané, Beyla, Macenta, and between Macenta and N'Zébela (Chabanaud 1921). The two latter sites are in the forest zone, the last one even at the southern edge of Ziama Forest which is remarkable for a species considered to be a savanna form (Grandison 1968, Hoogmoed 1968, Joger 1979, Joger & Lambert 2002). Grandison (1968) overlooked Chabanaud's (1921) records and cited only the original description of *A. sankaranica*. Rödel & Bangoura (2006) recorded *A. sankaranica* also from Mt. Béro.

Agama agama (Linnaeus, 1758) complex

Material examined: ZFMK 56080–088, Sérédou; ZFMK 56127–128, N'Zérékoré, W. Böhme coll. 6–26 Oct., 1993.

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Remarks: The "margouillat" of the local people is widely distributed and very common in human habitations (major cities as well as small villages), forest edges and clearings which it penetrates from its primary savanna habitats along roads.

A. agama is in urgent need of revision and is likely to contain more than one species also in West Africa (for East Africa members of the species complex see e.g. Böhme et al. 2005). This view is strongly supported by a female described by Klaptocz (1913) possessing more than twice as big scales as compared to other specimens from the same locality. Similarly big-scaled agamas have been photographed also by Dr. Guy Kremer (pers. comm.) in the western parts of Guinea. Attributing available names to the Guinean population(s) (*africana* Hallowell, *bocourti* Rochebrune, *savattieri* Rochebrune) seems premature before completion of a major revision currently carried out by one of us (PW).

Fig. 11. *Hemidactylus fasciatus*, juvenile from Mt. Nimba (Photo: C. Brede).

Chamaeleonidae

Chamaeleo gracilis Hallowell, 1844

Material examined: ZFMK 56142, subadult, forest near Malweta, southern Ziama Forest, W. Böhme coll. 6–26 Oct., 1993.

Remarks: *C. gracilis* is the only chameleon in West Africa living also in moist, forested areas where it seems to be rare. Only four other localities have been reported from Guinée forestière, viz. Mt. Nimba (Angel et al. 1954 a), Mt. Béro (Rödel & Bangoura 2006) and two sites in the western Guinean region of Boké (Hillers et al. 2006). Also Klaptocz (1913) got only one specimen in the moist savanna near Dabola (140 km E of Mamou) and called it rare and even unknown to the locals. In contrast, Dr. Guy Kremer (pers. comm., see ZFMK vouchers mentioned above) found it, along with the rarer *C. senegalensis*, to be more common near Kindia. A further specimen, also from a savanna habitat in PN Haut Niger has also been mentioned above. In the savanna areas of the Simandou range *C. senegalensis* was the only chameleon species recorded so far (Rödel & Bangoura 2004b; CB further unpubl. data).

Gekkonidae

Cnemaspis occidentalis Angel, 1943

Material examined: ZMB 75507, Mt. Nimba, 1274 m a.s.l., L. Sandberger coll. 5 August 2008.

Remarks: Recorded from the Mt. Nimba area already by Ineich (2003).

Hemidactylus angulatus Hallowell, 1854

Material examined: ZFMK 56368, 56140–141, 62172, Sérédou; ZFMK 56129–131, N'Zérékoré; ZFMK 60766, forest near Sérédou, W. Böhme coll. 6–26 Oct. 1993; ZFMK 82162: Diécké Forest (07E35'46.9"N, 08E52'18.8"W), 454 m asl., degraded forest, M.-O. Rödel & M.A Bangoura coll. 24 Nov. 2003.

Remarks: *H. angulatus* proved to be common in both forest areas visited. It was found on house walls and also within houses and lived in partial syntopy with *H. mabouia,* but seemed to be more numerous than the latter. The specimens from Diécké Forest were included in the table by Rödel & Bangoura (2006) as *H. brooki* of which *H. angulatus* figured as a subspecies before. Under the same name the species has been likewise listed from western Guinea (Hillers et al. 2006).

Hemidactylus fasciatus Gray, 1842

Material examined: ZFMK 82161, Diécké Forest (see above), 454 m a.s.l., degraded forest, M.-O. Rödel & M.H. Bangoura coll. 24 Nov. 2003.

Remarks: This record was already mentioned in the table provided by Rödel & Bangoura (2006). A further speci-

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men, likewise from Diécké Forest, was found by WB preserved in the "Centre Entomologique" of Herold Olsen in N'Zérékoré. MOR observed the species to be not uncommon within the forests of the Simandou range and CB took pictures of a juvenile on Mt. Nimba (Fig. 11).

Hemidactylus mabouia (Moreau de Jonnès, 1818)

Material examined: ZFMK 72303, Mt. Nimba, Gbakoro, N'Zo and Zougué, 500 m a.s.l., native collector 26–30 Aug. 1999.

Remarks: Not recorded from Mt. Nimba area by Ineich (2003). As already stated above, *H. mabouia* lives in syntopy with *H. angulatus* on the same housewalls in N'Zérékoré, but in lesser numbers. Rödel & Bangoura (2006) found it in Diécké Forest. In Sérédou, where *H. angulatus* is common in human habitations, *H. mabouia* seemed to be completely absent.

Hemidactylus muriceus Peters, 1870

Material examined: ZFMK 58617, Diécké Forest, W. Böhme coll. 15 Oct. 1993; ZFMK 82171, Mt. Béro (8E8'20.7"N, 8E34'23.7W), river and gallery forst, M.A. Bangoura & M.-O. Rödel coll. 1 Dec. 2003; ZFMK 82163, Diécké Forest (7E35'46.9"N, 8E52'18.8"W), 454 m asl., degraded forest, M.A. Bangoura & M.-O. Rödel coll. 21–23 Nov. 2003; ZFMK 82164, Diécké Forest, (7E35'43.6N, 8E51'52.3"W), creek in good forest, M.A. Bangoura & M.-O. Rödel, 27 Nov. 2003.

Remarks: There has been much confusion as to the identity of *H. muriceus*, *H. echinus* and *H. pseudomuriceus*; ZFMK 58617 was the first unambiguous specimen of *H. pseudomuriceus* from Guinea (Henle & Böhme 2003), followed now by the two additional voucher specimens from Mt. Béro Classified Forest (Rödel & Bangoura 2006). Further specimens of this forest gecko have been observed in the lowland forests of Mt. Nimba (MOR), and the Pic de Fon/Simandou range (Rödel & Bangoura 2004b).

Scleroglossa
Lacertidae

Holaspis guentheri Gray, 1863

Material examined: ZFMK 60563, near Sérédou, W. Bützler coll. Jan./Apr. 1995.

Remarks: One further specimen was observed by WB on a big fallen tree trunk near Malweta but could not be collected, despite the unusually low habitat structure of this otherwise strictly canopy-dwelling lizard. A specimen from Diécké Forest collected by H. Olsen (ca. 1950) is kept in ZMUC. For Guinea, this species was before only recorded from the Mt. Nimba region (Angel et al. 1954; see also Ineich 2003).

Scincidae

Cophoscincopus durus (Cope, 1862)

Material examined: ZFMK 82165, Diécké Forest, 454 m asl., 7E35'46.9"N, 8E52'18.8"W, degraded forest, M.A. Bangoura & M.-O. Rödel coll. 21.–23 Nov. 2003; ZFMK 82166, Diécké Forest, 7E35'43.6"N, 8E51'52.3", creek in good forest, M.A. Bangoura & M.-O. Rödel coll. 27 Nov. 2003.

Remarks: For distribution in West Africa and sympatry with the two congeners listed below see Böhme et al. (2000: map) and Ineich (2003).

Cophoscincopus greeri Böhme, Schmitz & Ziegler, 2000

Material examined: ZFMK 57599, male (holotype): Mt. Nimba, 1800 m asl., W. Böhme coll. Oct. 1993; ZMB 75500–7501, Mt. Nimba, A. Hillers coll. May 2006.

Remarks: The male holotype was earlier tentatively assigned to *C. simulans* by Böhme (1994 c). The *C. simulans* female figured in the same paper (ZFMK 57843), however, proved actually to belong to this revalidated species, so that the photographs showing ZFMK 57599 during alternate copulations with this female document a voluntary interspecific pairing.

Cophoscincopus simulans (Vaillant, 1884)

Material examined: ZFMK 56148, 57843, females, Malweta south of Sérédou, W. Böhme coll. 2–26 Oct 1993; ZFMK 82167, Diécké Forest, 7E35'43.6"N, 8E51'52.3"W, creek in primary forest, M.A. Bangoura & M.-O. Rödel coll. 27 Nov. 2003; ZFMK 82168–170, Mt. Béro, 8E8'20.7"N, 8E34'23.7"W, river and gallery forest, M.A. Bangoura & M.-O. Rödel coll. Dec. 2003; ZFMK 82178–180, Déré Forest, 444 m asl., 7E36'13.2"N, 8E!12'42.3"W, M.A. Bangoura & M.-O. Rödel coll. 17 Dec. 2003; ZMB 75502–77505, Mt. Nimba, A. Hillers coll. May 2006.

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Remarks: For the West African distribution and sympatry with the two above congeners see Böhme et al. (2000: map) and Ineich (2003).

Panaspis nimbensis (Angel, 1944)

Material examined: ZFMK 56147, Sérédou, on PROGERFOR compound under leaf litter. W. Böhme coll. Oct. 1993.

Remarks: This little skink was described from Nimba Mts. (Angel 1944, Angel et al. 1954 a), and Ineich (2003) summarized the Guinean voucher material of MNHN which is entirely from the Mt. Nimba area. After 40 years, our Ziama specimen is the first from outside of Nimba Mts. (see Böhme 1994 c). *P. nimbensis* is otherwise known from Ivory Coast (Perret 1973).

Trachylepis affinis (Gray, 1838)

Material examined: ZFMK 56143–145, Sérédou, W. Böhme coll. 2.–26. Oct 1993; ZFMK 58611–612, Diécké Forest, W. Böhme coll. 2–26 Oct. 1993.

Remarks: A common species (see also Rödel & Bangoura 2006) with a wide variety of habitats occupied, from primary forest where it lives on the ground as well as on high tree trunks (see Figs. in Böhme 1994 a, c) to secondary forests, bushland and human habitations (housewalls). In primary forests the species is usually restricted to more open sites such as tree fall gaps (MOR, unpubl. data).

Trachylepis maculilabris (Gray,1845)

Material examined: ZFMK 56146, Sérédou, W. Böhme coll. 2–26 Oct. 1993.

Remarks: Proved to be much rarer in SE Guinea (in contrast to e.g. Cameroon: see Herrmann et al. 2005) than *T. affinis,* and the voucher specimen was the only specimen seen. In comparison to *T. affinis*, this species is more closely connected to forest.

Amphisbaenidae

Cynisca cf. *liberiensis* (Boulenger, 1878)

Material examined: ZFMK 60564, Ziama Forest near Sérédou. W. Bützler coll. Jan./Apr. 1995.

Remarks: Found in the stomach of a roadkilled *Polemon acanthias* (ZFMK 60567).

The prey as well as its predator have been badly damaged by the vehicle that killed the snake. The head of the amphisbaenian is additonally damaged by beginning digestion within the snake, one mandible being already freely macerated, without teeth. We assign this specimen with some reservation to *Cynisca liberiensis* because this species is known from two Mt. Nimba localities: Angel et al. (1954 a) reported it from Pierré-Richaud and from Kéoulenta as *C. lamottei* (Angel, 1943), a name which has been synonymized by Gans (1987) with *C. liberiensis* and has been considered to be subspecifically valid by Ineich (2003). The diagnostic characters given by Gans (1987) can mostly not be verified any more, however, two characteristics still visible in our specimen ("small, relatively slender" and "some specimens showing mottling of the dorsal segments") do at least not argue against our tentative assignment. Recovery of intact specimens from Ziama Forest has to be awaited for.

Varanidae

Varanus ornatus (Daudin, 1803)

Material examined: ZFMK 56028, Sérédou (Mt. d'Antenne), native collector coll. 6–26 Oct. 1993, ZFMK 56029–030 (juvs.), Sérédou (agricultural area), native collectors coll. 18 Oct. 1993.

Remarks: The adult male ZFMK 56028 had been caught in a poacher's noose in primary forest on the "Antenna Hill", Sérédou. The juveniles were brought by Sérédou locals to the PROGERFOR compound. Further juveniles have been observed by WB nearby at Malweta river, and a juvenile specimen collected in Diécké Forest was also found in the "H. Olsen Entomological Center" in N'Zérékoré. All specimens seen showed the dorsal pattern of only five oblique rows of light ocelli, and the voucher specimens checked have a whitish to flesh-coloured tongue, both characters being diagnostic for *V. ornatus* which meets its parapatric sister species *V. niloticus* in Guinea (Böhme & Ziegler 1997, see also Greenbaum & Carr 2005). Whereas the latter has already been termed common by Chabanaud (1921) and is also represented in our Haut Niger National Park material (see above, and Greenbaum & Carr 2005), the *ornatus* specimens are the first representatives of the forest species *V. ornatus* documented for the country.

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Fig. 12. *Typhlops liberiensis*, Diani River, near Nzérékoré (Photo: W. Böhme).

Fig. 13. *Python sebae*, subadult specimen from Mt. Nimba (Photo: C. Brede).

Typhlopidae

Typhlops liberiensis (Hallowell, 1848)

Material examined: ZFMK 56090, adult female. Sérédou, W. Böhme coll. 12 Oct. 1993; ZFMK 56135, Diani River, W. Böhme coll. 13 Oct. 1993.

Remarks: The taxonomic status of this irregularly speckled blind snake (Fig. 12) is not yet stabile. Sometimes it is also regarded to be a subspecies of *T. punctatus*, or even of *T. congestus* (see Ineich 2003).

Typhlops punctatus Leach, 1819

Material examined: ZFMK 58620, Sérédou, W. Bützler coll. Aug./Nov. 1994.

Remarks: Another specimen of this taxon was seen in the H. Olsen collection in N'Zérékoré.

Boidae

Calabaria reinhardtii (Schlegel, 1848)

Material examined: ZFMK 56042, north of Sérédou (on road to Macenta) through primary forest, W. Bützler coll. 25 Oct. 1993.

Remarks: A second individual was seen in the "Centre Entomologique" in N'Zérékoré (H. Olsen coll.). According to Ineich (2003), a third specimen was collected at Ziéla, Mt. Nimba; it is not kept in MNHN but "dans les collections guinéennes du mont Nimba (Lamotte, comm. pers. 09/97)". Thus, our specimen from Sérédou, though badly damaged as a roadkill, is the only Guinean specimen available for study.

Pythonidae

Python sebae (Gmelin, 1789)

Material examined: Photographic voucher.

Remarks: In the Mt. Nimba area, a subadult rock python could be photographed by CB (Fig. 13).

Lamprophiidae

Bothrophthalmus lineatus Peters, 1863

Material examined: ZFMK 56094, south of Sérédou, Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 58615, Diécké Forest, H. Vierhaus coll. Apr. 1994; ZFMK 82159, Diécké Forest (7.35 N; 8.51 W), M.A. Bangoura & M.-O. Rödel coll. 27 Nov. 2003 (Fig. 14).

Remarks: Some authors, including Angel et al. (1954 b) and Ineich (2003), refer to this snake as *B. lineatus lineatus*, which implies conspecifity of the central African

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Fig. 14. *Bothrophthalmus lineatus,* ZFMK 82159, from Diécké Forest (Photo: C. Brede).

taxon *brunneus*. However, as east of the distribution range of the latter (eastern DRC, Ruanda) again typical *lineatus* are found, we prefer to regard both distinct forms as separate species.

ZFMK 56094 contained remains of an unidentified small rodent.

Lamprophis lineatus (Duméril, Bibron & Duméril, 1854)

Material examined: ZFMK 56125 and 56126, Ziama Forest south of Sérédou: Malweta village, W. Bützler coll. 1991/92 and W. Böhme 6–26 Oct. 1993, respectively.

Lamprophis olivaceus (Duméril, 1856)

Material examined: 56121–122, Ziama Forest north of Sérédou: Balassou village, W. Böhme coll. 6–26 Oct. 1993; 58610, Ziama Forest west of Sérédou: Soundédou village, W. Bützler leg. Apr. 1994.

Fig. 15. *Lycophidion* sp., ZMB 75508 from Mt. Tétini, Déré Forest (Photo: C. Brede).

Lamprophis virgatus (Hallowell, 1854)

Material examined: ZFMK 56123, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 56264, same locality, W. Bützler coll. Nov. 1993; ZFMK 57809, Sérédou, W. Böhme coll. 6–26 Oct. 1993; ZFMK 60556 and 60770, same locality, W. Bützler coll. Jan./Apr. and June/Aug. 1994 respectively.

Remarks: ZFMK 57809 was recovered from the stomach of a *Mehelya guirali* (ZFMK 56041).

Lycophidion sp.

Material examined: ZMB 75508, Mont Tétini, N 08°20.348', W 08°22.741', gallery forest, small river, rapids, some swampy areas, C. Brede, M.A. Bangoura, J. Doumbia coll. 21 Sep. 2008.

On Mt. Tétini we collected a snake (Fig. 15) where pholidosis was closest to *L. irroratum*. However, we recorded distinct differences in scalation and colour pattern, compared to Chippaux (2001) or *L. irroratum* specimens known to us from other West African localities, e.g. Comoé National Park, Ivory Coast (SMNS 8469.1–2, Rödel et al. 1995, 1999) or Pendjari National Park, Benin (MOR, unpubl. data). The taxonomic status of this snake needs further investigation.

Mehelya guirali (Mocquard, 1887)

Material examined: ZFMK 56041, Ziama Forest near Sérédou, road in primary forest, W. Böhme coll. 6–26 Oct. 1993; ZFMK 58627, Ziama Forest near Sérédou, W. Bützler coll. Dec. 1994.

Remarks: ZFMK 56041 had a *Lamprophis virgatus* (ZFMK 57809) in its stomach.

The above two specimens (ID verified by B. Hughes) were mentioned by Böhme (2000) as the first country record of this species. Five more specimens from the Guinean and Liberian part of Mt. Nimba are kept in MNHN (Ineich 2003).

Mehelya poensis (Smith, 1847)

Material examined: ZFMK 56111, south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct 1993; ZFMK

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Fig. 16. *Dasypeltis scabra*, ZFMK 75496, from Mt. Nimba (Photo: M.-O. Rödel).

60569, Ziama Forest near Sérédou, W. Bützler coll. Jan./Apr. 1995.

Remarks: ZFMK 56111 (ID verified by B. Hughes) contained unidentifiable remains of a snake.

Mehelya stenophthalmus (Mocquard, 1887)

Material examined: ZFMK 56112, south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993.

Colubridae

Crotaphopeltis hotamboeia (Laurenti, 1768)

Material examined: ZFMK 54896, Sérédou, H. Vierhaus coll. 4 Aug. 1992; ZFMK 56116–120, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 60568, Ziama Forest near Sérédou, W. Bützler coll. Jan./Apr. 1995; ZFMK 62173–175, Sérédou, W. Bützler coll. Nov./Dec. 1995.

Remarks: With ten specimens from Ziama Forest the second most common snake of our survey. Three specimens had food items in their intestinal tracts: ZFMK 54896 anuran and insect remains, ZFMK 56116 one *Amietophrynus maculatus*, and ZFMK 60568 unidentifiable remains of a mouse.

Dasypeltis fasciata Smith, 1849

Material examined: ZFMK 56048, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 2–26 Oct. 1993.

Remarks: First reported for Guinea by Böhme (2000). Ineich (2003) recorded three MNHN specimens from the Mt. Nimba area. One was catalogued in 1943 and reidentified by C. Gans, the two others in 1962. The identification of our specimen, the only Guinean one known from outside of Mt. Nimba, was verified by B. Hughes. Recently, Trape & Mané (2006 a) reported and figured a specimen from Ziama Forest.

Dasypeltis scabra (Linnaeus, 1758)

Material examined: ZMB 75496, Mt. Nimba, Grand Rocher, 1600 m a.s.l., M.-O. Rödel & L. Sandberger coll. 1 Jul. 2007.

Remarks: Reported from Mt. Nimba by Ineich (2003). The colour pattern of our voucher specimen (Fig. 16) is very similar to the specimen figured by Trape & Mané (2006 a, Fig. 5c) as *D.* cf. *scabra*.

Dipsadoboa brevirostris (Sternfeld, 1908)

Material examined: ZFMK 56096, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 82173, Mont Béro, 8E08'23.7 N, 8E34'23.7 W), M.A. Bangoura & M.-O. Rödel coll. 30 Nov. 2003.

Remarks: ZFMK 56096 is a gravid female with three eggs inside. The specimens fit the description of *Leptodira guineensis* Chabanaud, 1920, described from the neighbouring Diécké Forest. This taxon was synonymized with *brevirostris* Sternfeld by Rasmussen (1989, see also Rasmussen 1994). Not listed for Mt. Nimba (Angel et al. 1954 b, Ineich (2003).

Dipsadoboa unicolor Günther, 1858

Material examined: ZFMK 56095 & 56267, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 56267, same locality, W. Bützler coll. Nov. 1993; ZFMK 82160, Diécké Forest (7.35 N; 8.51 W), M.A. Bangoura & M.-O. Rödel coll. 27 Nov. 2003, photographic voucher from Mt. Béro (Fig. 17).

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Fig. 17. *Dipsadoboa unicolor* from Mt. Béro (Photo: M.-O. Rödel).

Remarks: ZFMK 56095 and 56267, two males, prove their identity as true *D. unicolor* by having 70 and 75 undivided subcaudals respectively (Rasmussen 1993, 1994). They are strikingly differently coloured, ZFMK 56095 being dark bluish-green, and ZFMK 56267 light green (meanwhile light bluish in preservative).

Hapsidophrys lineata Fischer, 1856

Material examined: ZFMK 56089, between Macenta and Sérédou, W. Bützler coll. 25 Oct. 1993.

Remarks: The adult, roadkilled specimen is headless.

Hapsidophrys smaragdina (Schlegel, 1837)

Material exmined: ZFMK 56043–046, 56149, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct 1993; ZFMK 60769, Sérédou, W. Bützler coll. June/Aug. 1995.

Remarks: Collected by R. Pujol at Sérédou before (Condamin 1959), but – remarkably – not listed for the Mt. Nimba area (Ineich 2003).

Meizodon coronatus (Schlegel, 1837)

Material examined: ZFMK 56133, N'Zérékore, H. Olsen coll. ca. 1950.

Remarks: This specimen from N'Zérékoré was donated to ZFMK by the women responsible for the Olsen collection in 1993. For the taxonomic and nomenclatural confusion between this and the following species see Roux-Estève (1969) and below.

Meizodon regularis Fischer, 1856

Material examined: ZFMK 56113–115, 56261, south of Sérédou: Malweta village, ZFMK 56260, Sérédou, W. Böhme coll. 6–26 Oct. 1993.

Remarks: Roux-Estève (1969) revised the West African portion of the genus and reached the conclusion that *M. coronatus* and *M. regularis* are two distinct species with broadly overlappping ranges, a view corroborated by Schätti (1985). She listed also several Guinean localities for this species she had found in various collections in the course of this work. These localities are spread all over Guinea. Böhme (2000) and Ineich (2003), not citing Roux-Estève (1969) referred to Angel et al. (1954 b) who had listed all his specimens still under *M. coronatus*. Therefore, Böhme (2000) erroneously believed his specimens to be new for Guinea, while Ineich (2003) could recheck the MNHN material and was able to quote *M. coronatus* sensu Angel (1954 b) as a partial chresonym of *M. regularis*.

Philothamnus carinatus (Andersson, 1901)

Material examined: ZFMK 56265, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 57230, Ziama Forest: Gboda village, W. Bützler coll. Feb. 1994.

Remarks: identification verified by B. Hughes, July 1994.

Philothamnus heterodermus (Hallowell, 1857)

Material examined: ZFMK 56138–139, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 8–26 Oct. 1993; ZFMK 58623, Sérédou, W. Bützler coll. Aug./Nov. 1994; ZFMK 82172, Mt. Béro (8.08 N; 8.34 W), M.A. Bangoura & M.-O. Rödel coll. 30 Nov. 2003.

Philothamnus irregularis (Leach, 1819)

Material examined: ZFMK 82177, Mt. Nimba area: Mt. Tò (7.39 N; 8.29 W), M.A. Bangoura & M.-O. Rödel coll. 21 Nov. 2003.

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Thelotornis kirtlandii (Hallowell, 1844)

Material examined: ZFMK 60767, Ziama Forest near Sérédou, W. Bützler coll. June/Aug. 1995.

Remarks: Recorded by Villiers (1950, 1954) and Angel et al. (1954 b) from Mt. Nimba (Ineich 2003). ZFMK 60767 seems to be the first Guinean specimen found outside the Mt. Nimba range and has been mentioned and figured already by Riquier & Böhme (1996). The species was also found by Rödel & Bangoura (2006) in Diécké Forest.

Thrasops occidentalis Parker, 1940

Material examined: ZFMK 56033, Sérédou, road in primary forest, W. Böhme coll. 6–26 Oct. 1993.

Remarks: This specimen had a largely digested and thus unidentifiable anuran in its stomach. Moreover, it was mentioned as a first country record by Böhme (2000) who overlooked, however, the record from Dalaba by Villiers (1950). From 1986–1990 the species was also found in the Mt. Nimba region of Guinea and Liberia (Ineich 2003).

Toxicodryas blandingii (Hallowell, 1844)

Material examined: ZFMK 54889, Sérédou (in house), H. Vierhaus coll. 4 Aug. 1992; ZFMK 56031–032, Sérédou, agricultural area, W. Böhme coll. 6–26 Oct. 1993; ZFMK 56040, Sérédou, road in primary forest, W. Böhme coll. 6–26 Oct. 1993; 56277–278, Ziama Forest south of Sérédou: Malweta village, W. Bützler coll. Nov. 1993.

Remarks: ZFMK 56032 had two weaverbirds in its stomach. The species is very common at and around the former Nimba research station (1000 m asl.).

Toxicodryas pulverulentus (Fischer, 1856)

Material examined: ZFMK 56039, Sérédou, W. Böhme coll. 6–26 Oct. 1993; ZFMK 58625–626, same locality, W. Bützler coll. Aug./Nov. 1994; 60768 and 62178, same locality, W. Bützler coll. June/Aug. 1995 and Aug./Nov. 1995 respectively.

Remarks: Two specimens had food items in their stomach: ZFMK 56039 several mice, and ZFMK 58265 a lizard (*Agama agama* complex).

Natricidae

Afronatrix anoscopus (Cope, 1861)

Material examined: ZFMK 56049–079, Ziama Forest south of Sérédou, Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 56256, Sérédou (Mt. d'antenne), ZFMK 56268–276 Malweta village, W. Bützler coll. Nov. 1993; ZFMK 58609, Ziama Forest west of Sérédou: Soundédou, W. Bützler coll. Apr. 1994; ZFMK 82158: Diécké Forest (7.31 N; 8.50 W), M.A. Bangoura & M.-O. Rödel coll. 27 Nov. 2003.

Remarks: *A. anoscopus* is one of the most common snakes in SE Guinea. We recorded them in small streams of almost all forests, i.e. in the Pic de Fon area, Diécké, and on Mt. Nimba. The most common colour morph is uniform brown (Fig. 18) to brilliant reddish, fewer individuals have yellowish brown bodies with black occular spots (Fig. 19). This species proved to be eudominant in the snake community of Ziama Forest: 42 specimens were collected, followed by the two next-common species (*Crotaphopeltis hotamboeia* and *Natriciteres variegata*) with just ten and nine individuals respectively (see Böhme 2000). Because of this sample size of the Ziama population, some morphological and nutritional data gathered from this series seem to be useful:

– Size: snout-vent length 14.6.–45.5 cm, mean 35.54; tail length 4.6–15.9 cm, mean 11.6 cm. Largest specimen is a female (ZFMK 56074): 60.4 cm.

– Scalation: Dorsals around midbody 23 in all but two (ZFMK 56063, 56079, which both have 25) specimens; ventrals 139–151; subcaudals 64–82; anal divided in 36 specimens, entire in 4. Lateral keeling of subcaudals distinct in 36 specimens, indistinct in 4, and lacking in 2; supralabials 9 on both sides of head in 33 specimens, 8–9 (left/right side of head) in 2, and 9–10 in 3.

– Colour pattern: 32 specimens have a marked pattern of black spots arranged in longitudinal rows on a lighter ground colouration; in two specimens, the spots are indistinct, and in eight instances, they are lacking, the respective individuals being unicoloured.

– Taxonomy: Angel (1932) synonymized *Helicops gendrii* Boulenger, 1910: type locality "Labé, French Guinea" with *Tropidonotus anoscopus* Cope, 1861 (type locality Liberia, but Villiers (1950) used the name *Natrix a. gendrii* (Boulenger, 1910 for the Guinean populations to distinguish them from the nominotypic *N. a. anoscopus* (Cope, 1861: type locality Liberia). The few morphometric data published so far from West Africa show that the variability of this widely distributed snake only within

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Fig. 18. *Afronatrix anoscopus*, unicoloured specimen from Mt. Nimba (Photo: C. Brede).

Fig. 19. *Afronatrix anoscopus*, patterned specimen from Pic de Fon (Photo: C. Brede).

Guinea exceeds that of our series in most of the data taken. A modern revision including also the central African populations seems highly desirable.

– Nutrition: Of the 42 specimens from Ziama Forest, only three individuals had full stomachs (with fishes), viz. ZFMK 56066 (*Aplocheilichthys schioetzi*), 56076 (*Kribia* cf. *nana*), and 56275 (*Aplocheilichthys schioetzi* and unidentifiable frog remains).

Grayia smithii (Leach, 1818)

Material examined: ZFMK 56036, adult female, south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; photographic voucher: a big, light-coloured road-killed specimen from the road between Sérédou and Zoboroma, W. Bützler phot. March 1995.

Remarks: This specimen had several fishes (*Tilapia* (*Coptodon*) sp.n.?) in its stomach. The bad shape of the fishes from the stomach of this snake does not allow a precise identification, but it seems likely that they belong to an undescribed species (J. Freyhof, pers. comm.).

Another big female of this species, likewise from Malweta village, was left for the PROGERFOR teaching collection at Sérédou.

Natriciteres variegata (Peters, 1861)

Material examined: ZFMK 56097–099, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 56257–258, Sérédou, W. Bützler coll. Nov. 1993; ZFMK 56262–263, Malweta village, W. Bützler coll. Nov. 1993; ZFMK 58622 and 60579, Sérédou, W. Bützler coll. Aug./Nov. 1994 and Jan./Apr. 1995 respectively.

Remarks: With nine specimens the third most common snake species in WB's Ziama Forest survey.

Psammophiidae

Psammophis phillipsi (Hallowell, 1844)

Material examined: ZFMK 56047, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 60792, Sérédou, W. Bützler coll. June/Aug. 1995.

Remarks: Both specimens have the ventrals shaded with grey, thus representing the true, forest-dwelling *P. philippsi*. Moreover, the smaller specimen is dorsally unicoloured which is also characteristic. *P.* cf. *phillipsi*, often referred to as *P. sibilans* in West Africa, has a striped juvenile dress which fades in adults of this savanicolous species (Böhme et al. 1996).

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Atractaspididae

Aparallactus lineatus (Peters, 1870)

Material examined: ZFMK 56100, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993.

Remarks: The validity of this species and its specific distinctness from *A. niger* was proven by Wallach (1994), lastly based on the sympatric occurence of both species "from the same rainforest locality" near Mt. Nimba. Here, again both species are recorded from the same forest locality (Malweta village, see below).

Aparallactus modestus (Günther, 1859)

Material excamined: ZFMK 56105, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 82157, Diécké Forest (N 7.35; W 8.12), M.A. Bangoura & M.-O. Rödel coll. 21/23 Nov. 2003 (Fig. 20).

Remarks: At Malweta village, next to *A. lineatus* and *A. niger*, the sympatric occurrence of the third congener is proven.

Fig. 20. *Aparallactus modestus*, ZFMK 82157, from Diécké Forest (Photo: M.-O. Rödel).

Aparallactus niger Boulenger, 1897

Material examined: ZFMK 56101–102, Ziamam Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct 1993; ZFMK 56266, same locality, W. Bützler coll. Nov. 1993; ZFMK 60565, Sérédou, W. Bützler coll. Jan./Apr. 1995.

Remarks: See above under *A. lineatus*.

Atractaspis irregularis (Reinhardt, 1843)

Material examined: ZFMK 56106–108, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 6–26 Oct. 1993; ZFMK 58624, Sérédou, W. Bützler coll. Aug./Nov. 1994.

Remarks: Ineich (2003) listed several specimens from the IFAN and MNHN collections from localities in the Mt. Nimba range, but did not include *A. aterrima* in his paper, although Rasmussen (2005) found several vouchers of this last named species in both collections.

Polemon acanthias (Reinhardt, 1860)

Material examined: ZFMK 56103–14, Ziama Forest south of Sérédou, W. Böhme coll. 6–26 Oct. 1993; ZFMK 56259, Sérédou ("Mt. d'Antenne"), W. Bützler coll. Nov. 1993; ZFMK 60567, Sérédou, W. Bützler coll. Jan./Apr. 1995; ZFMK 62176, same locality, W. Bützler coll. Nov./Dec. 1995.

Remarks: The road-killed specimen ZFMK 60567 contained a *Cynisca* cf. *liberiensis* (see above).

Elapidae

Dendroaspis viridis (Hallowell, 1844)

Material examined: ZFMK 54890–891, Sérédou, H. Vierhaus coll. 4 Aug. 1992; ZFMK 56034–035, Sérédou, W. Böhme coll. 2–26 Oct. 1993.

Remarks: *D. viridis* proved to be quite common in Sérédou and was regularly observed in the compound of PROGERFOR.

Naja melanoleuca Hallowell, 1857)

Material examined: ZFMK 56091–092, juvs., Ziama Forest south of Sérédou: Malweta village; ZFMK 62177, Ziama Forest near Sérédou, W. Bützler coll. Nov./Dec. 1995.

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Remarks: Recorded by Rödel & Bangoura (2006) also from Diécké Forest.

Naja nigricollis Reinhardt, 1843

Material examined: ZFMK 56037: Sérédou. W. Bützler coll. 1991/92.

Remarks: Rödel & Bangoura (2006) listed this species also from Mt. Béro.

Pseudohaje nigra Günther, 1858

Material examined: ZFMK 56134, N'Zérékoré, ex coll. H. Olsen, received Oct. 1993.

Remarks: Ineich (2003), based on David & Ineich (1999), claimed that the presence of this species in Guinea was still uncertain although it was likely to occur, due to a MNHN specimen from the Liberian part of Mt. Nimba (Ineich 2003). However, both Roman (1976: "On possède en collection un exemplaire de N'Zérékoré, Guinée") and Böhme (2000: based on ZFMK 56134) had reported *P. nigra* already from Guinea.

Viperidae

Atheris chlorechis (Pel, 1851)

Material examined: ZFMK 56109–110, Ziama Forest south of Sérédou: Malweta village, W. Böhme coll. 2–26 Oct. 1993; ZFMK 82174, Mt. Béro, M.A. Bangoura & M.-O. Rödel coll. 5 Dec. 2003.

Remarks: Known in Guinea from the Mt. Nimba area (Villiers 1950, Angel et al. 1954 b, Ineich 2003), but also already reported from Sérédou (Condamin 1959). A Mt. Nimba specimen is depicted in Fig. 21.

Fig. 21. *Atheris chlorechis* from Mt. Nimba (Photo: C. Brede).

Bitis arietans Merrem, 1820

Material examined: Photographic voucher by MOR from Pic de Fon, 1600 m.

Remarks: Apart from the altitude, this photographic record (Fig. 22) is remarkable because it shows a dorsal pattern where the light chevron marks typical for this species vanish already after the first half of the body, passing gradually into subquadrangular light spots. The same pattern type is seen in the photographic voucher from Kissidougou mentioned above and seems to be commoner in West Africa than a chevron-mark pattern along the entire body as it is typical for eastern and southern African populations.

Fig. 22. *Bitis arietans*, specimen from Pic de Fon, 1600 m, note the restriction of chevron pattern to the anterior half of body (Photo: M.-O. Rödel).

Bitis nasicornis (Shaw, 1802)

Material examined: ZFMK 56038, Sérédou, W. Bützler coll. 1991/92. A further specimen was photographed in Ziama by CB in 2010.

Bitis rhinoceros (Schlegel, 1855)

Material examined: ZFMK 56126, between Sérédou and Macenta, W. Böhme & W. Bützler coll. 23. Oct. 1993.

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Remarks: Only the skin with head and tail inside of this big male (total length 105 cm) could be preserved in alcohol. A photographic record was made in the Fouta Djallon by CB (Labé/Daralabe/Forêt Kokoulo), an extreme western locality for this species.

Causus maculatus (Hallowell, 1842)

Material examined: ZFMK 56093, Ziama Forest south of Sérédou, W. Böhme coll. 6–26 Oct. 1993; ZFMK 60771 and 62179–180, Sérédou, W. Bützler coll. June/Aug. 1995 and Nov./Dec. 1995 respectively.

Remarks: Recorded by Rödel & Bangoura (2006) also from Déré Forest (Fig. 23).

Fig. 23. *Causus maculatus* from Déré Forest (Photo: M.-O. Rödel).

Fig. 24. *Osteolaemus tetraspis* killed by local hunter near Malweta village, Ziama Forest (Photo: W. Bützler).

Crocodylia
Crocodylidae

Represented in West Africa by three species, for which the slender-snouted species *Mecistops cataphractus* was reported to occur in the Baffing (= Bafing) river, upper Senegal river) by Klaptocz (1913). The Western Nile Crocodile (*Crocodylus suchus*) (see Schmitz et al. 2003) is savanicolous and was said to be common in the drier parts of the country.

Osteolaemus tetraspis (Cope, 1861)

Material examined: voucher photograph.

Remarks: The existence of the dwarf crocodile in Ziama Forest is proven by a photograph by W. Bützler (Fig. 24) taken near Sérédou in summer 1993. A particular site where the species was observed near Malweta is shown in Fig. 25. According to Villiers (1958), this species is

Fig. 25. Habitat near Malweta village where *O. tetraspis* was observed (Photo: W. Böhme).

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characteristic for the "forèts guinéennes" – Rödel & Bangoura (2006) recorded it from Diécké Forest – but also for gallery forests in the savanna, e.g. near Kérouané in Upper Guinea. Waitkuwait (1986, 1988, 1989) mentioned for Guinea the rivers Kourai, Sankarani, Boa, Bafing and Mafou of which only Boa and Bafing belong to the hydrographic system of the SE Guinean forest area.

Very recently, Eaton et al. (2009) challenged the conspecifity of West African dwarf-snouted crocodiles with typical *O. tetraspis* from the Ogooué basin (Gabon).

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Appendix I

Checklist of reptiles known from the Republic of Guinea

The following checklist does not aim to revise all following genus and species names. Some are adapted to modern use, but original use of the respective author's name is added. Only in case of small spelling differences e.g. *Chamaeleon* vs. *Chamaeleo*, *Dendraspis* vs. *Dendroaspis, smythii* vs. *smithii* etc. the original spelling has not been added. Quite a number of species identifications from the literature had to be taken *bona fide*, because a reinvestigation of old vouchers which might be necessary in view of more recent revisions is beyond the scope of this list.

Only references giving locality data were included but not those just enumerating only the country of occureence, except in such cases where no other and more detailed mentioning of the Republic of Guinea is made (see e.g. Welch 1982, Golay et al. 1993, Spawls & Branch 1995, David & Ineich 1999). A special problem is that the old reference "Guinea" or Guinée" can also refer to Ghana (David & Ineich 1999).

The families below are arranged systematically, with alphabetical order of genera and species within families.

Pelomedusidae

– *Pelomedusa subrufa* – Greenbaum & Carr (2005): PN Haut Niger (1st country record); Fouta Djallon, Pita/Hore Binti, N 10°51'21.3", W 12°32'40.2", photo records, C. Brede.

– *Pelusios castaneus* – Ineich (2003): Mt. Nimba; Greenbaum & Carr (2005): Kouroussa; PN Haut Niger; Hillers et al. (2006): Kolaboui.

– *Pelusios* sp. – Chabanaud (1921): Kérouané (= *P. castaneus* ??).

Testudinidae

– *Kinixys belliana* – Greenbaum & Carr (2005): PN Haut Niger.

– *Kinixys erosa* – Ineich (2003): Mt. Nimba; Rödel &Bangoura (2006): Diécké Forest; this paper: Sérédou, Macenta.

– *Kinixys homeana* – Chabanaud (1921): N'Zébéla (as *Cinixys homeana*).

Trionychidae

– *Trionyx triunguis* – Greenbaum & Carr (2005): PN Haut Niger (1st country record); this paper: Ziama Forest.

Agamidae

– *Agama agama* complex – Klaptocz (1913): Conakry, Dubreka, Mamou, Dabola, Tinkisso Betaja (as *A. colonorum*); Chabanaud (1921): "Très commun partout" (as *A. colonorum*); Angel et al. (1954 a): several localities in Mt. Nimba range; Grandison (1956): Mt. Nimba (see also Ineich 2003); Greenbaum & Carr (2005): PN Haut Niger; Rödel & Bangoura (2004b): Pic de Fon/Simandou range; Rödel & Bangoura (2006): Déré an Diécké Forests, Mt. Béro; Hillers et al. (2006): Kolaboui, Sangarédi; this paper.

– *Agama cristata* – Mocquard (1905): "Pays Sankaran" (on MNHN label: "Bomanesco, Sankaran); Chabanaud (1921): Sankaran. – Note: We regard the name *A. maria* nomen nov. Barabanov (2008) as invalid. Reasons are given by Wagner & Böhme (2009). We also disagree with Barabanov's (2009) view to locate "Pays Sankaran" in Mali rather than in Guinea.

– *Agama insularis* – Chabanaud (1918) Los Islands off Conakry; Parker (1939): Los Islands; Wagner et al. (2009): Kinkon water falls; Kindia (Pastoria station).

– *Agama sankaranica* – Chabanaud (1921): "Pays Sankaran" (see above under *A. cristata*), N'Zébéla; Rödel & Bangoura (2006): Mt. Béro.

Chamaeleonidae

– *Chamaeleo gracilis* – Klaptocz (1913): Dabola; Chabanaud (1921): Kérouané, Beyla; Ineich (2003): Mt. Nimba; Greenbaum & Carr (2005): PN Haut Niger; Rödel & Bangoura (2006): Mt. Béro; Hillers et al. (2006): Rio Kapatchet (Kamsar), Sangarédi; this paper: Kindia; Ziama Forest.

– *Chamaeleo senegalensis* – Chabanaud (1921): Beyla; Grandison (1956): Koundara; Rödel & Bangoura (2004b): Pic de Fon/Simandou range; this paper: Kindia; Fouta Djallon, Labé/Saala, N 11°17'13.9", W 12°30'13.5", photo record, C. Brede; Pic de Fon/Simandou range, M.A. Bangoura, C. Brede, M.-O. Rödel.

Eublepharidae

– *Hemitheconyx caudicinctus* – Mocquard (1908): Kouroussa (as Psilodactylus caudicinctus); Grandison (1956): Kankan; Greenbaum & Carr (2005): PN Haut Niger.

Phyllodactylidae

– *Tarentola parvicarinata* – Joger (1980): "nördliches Guinea"; this paper: Dabola/ Kouffo, Fouta Djallon, photo record C. Brede. – Note: The gecko on Fig. 26 was captured but not collected, but its habitus and (phalangeal) foot structure strongly suggest its allocation to *Tarentola parvicarinata*. This photographic voucher is the second country record of the genus and the first with precise locality data. Remarkably, it was found in a gallery forest habitat where it lived on stones offering it good camouflage.

Gekkonidae

– *Cnemaspis occidentalis* – Ineich (2003): Mt. Nimba, Ziéla, Nzo; this paper.

– *Hemidactylus angulatus* – Klaptocz (1913: Conakry, Mamou; Chabanaud (1921): Conakry, Kérouané, Beyla (as *H. brookii*); Grandison (1956): Kankan, Mamou (as *H. brookii angulatus*); Greenbaum & Carr (2005): PN Haut Niger; Rödel & Bangoura (2006): Diécké Forest (as *H. brookii*).

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Fig. 26. *Tarentola parvicarinata* from Fouta Djallon Mts., W Guinea (Photo: C. Brede).

– *Hemidactylus fasciatus* – Rödel & Bangoura (2006): Diécké Forest; this paper: Mt. Nimba, photo record, C. Brede.

– *Hemidactylus mabouia* – Rödel & Bangoura (2006): Diécké Forest); this paper.

– *Hemidactylus muriceus* – Henle & Böhme (2003): Diécké Forest; Rödel & Bangoura (2004b): Pic de Fon/ Simandou range; Rödel & Bangoura (2006): Diécké Forest and Mt. Béro; this paper; Mt. Nimba, photo records, C. Brede, M.-O. Rödel.

– *Hemidactylus* sp. (aff. *mabouia*): Coyah (this paper). – Note: Three specimens of this *Hemidactylus* similar to *H. mabouia* were captured but not collected on October 2, 1993 at the very beginning of WB's mission. They were active at night on the stony walls of huts in a small tourist resort in the tidal zone NE of Conakry. Despite our expectation, they were not found again, and a later comparison of the photographs revealed that they are different from *H. mabouia*, not only by the lack of the fine, wavy dorsal crosslines (which are lacking also in some other "*mabouia*" populations, e.g. in Benin, see Ullenbruch et al. 2010) but also by the presence of two pairs of two large, darkened saddle-like flecks separated by a light middorsal line (Fig. 27 & 28). Moreover, the lowermost flank tubercles were more strongly developed than in *H. mabouia* (see Figs.). We regard this commensal gecko to represent an undescribed species.

Lacertidae

– *Heliobolus nitidus* – Klaptocz (1913): Iryan on the Niger (as *Eremias nitida*).

– *Holaspis guentheri* – Angel et al. (1954 a): 3 places in the Mt. Nimba area; this paper: N'Zérékoré; near Sérédou.

Scincidae

– *Cophoscincopus durus* – Grandison (1956): Mt. Nimba; Ineich 2003): Mt. Nimba; Rödel & Bangoura (2006): Diécké Forest; this paper.

– *Cophoscincopus greeri* – Böhme (1994 c): Mt. Nimba (as *C. simulans*); Böhme et al. 2000: Mt. Nimba; Ineich 2003: Mt. Nimba; this paper.

– *Cophoscincopus simulans* – Chabanaud (1921): N'Zébéla, N'Zérékoré (as *Lygosoma simulans*); Böhme (1994 c, Böhme et al. 2000): Ziama Forest near Sérédou; Ineich 2003): Mt. Nimba; Rödel & Bangoura (2006): Déré and Diécké Forests and Mt. Béro; this paper.

– *Lepidothyris fernandi* – Chabanaud (1921): N'Zébéla (as *Lygosoma (Riopa) fernandi*); Grandison (1956): Mt. Nimba (as *Riopa fernandi*); Ineich (2003); Mt. Nimba (as *Lygosoma fernandi*).

– *Panaspis nimbensis* – Angel et al. (1954 a): Mt. Nimba; Böhme (1994 c): Sérédou: Ineich (2003): Mt. Nimba; this paper.

– *Panaspis togoensis* – Chabanaud (1917, 1921); Type locality "Haute Guinée française" (as *Paralygosoma monneti*, syn. fide J.L. Perret & A. Schmitz, pers. comm.); Greenbaum & Carr

Fig. 27–28. *Hemidactylus* sp. (n.?) from Coyah, SW Guinea (Photos: W. Böhme).

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(2005): PN Haut Niger (*L. "africanum"* in Chabanaud (1921: Kankan, Kérouané) certainly refers to this species).

– *Trachylepis affinis* – Klaptocz (1913): Conakry, Mamou, Konkouré, Iryan (as *Mabuia raddonii*); Chabanaud (1921): Kérouané, Beyla, Macenta, N'Zébéla, N'Zérékoré, Diécké, Sanikolé (as *M. raddonii*); Grandison (1956): Mt. Nimba (as *Mabuya blandingii*); photo record, C. Brede; Böhme (1994 c): Ziama Forest (as *M. affinis*); Ineich (2003, as *Euprepis affinis*): Mt. Nimba; Rödel & Bangoura (2004b): Pic de Fon/ Simandou range (as *Mabuya affinis*); Greenbaum & Carr (2005): PN Haut Niger; Hillers et al. (2006): Kolaboui, Rio Kapatchet (Kamsar), Sangarédi (as *Mabuya affinis*); this paper.

– *Trachylepis albilabris* – Angel et al. (1954 a, as *Mabuya Blandingii*), Hoogmoed (1974, as *M. affinis*), Ineich (2003, as *Euprepis albilabris*): several localities in the Mt. Nimba area; Rödel & Bangoura (2006): Déré & Diécké Forests and Mt. Béro (as *Mabuya affinis*).

– *Trachylepis keroanensis* – Chabanaud (1921): Kérouané (as *Mabuia perroteti* var. *keroanensis* ssp. n. – Note: The two syntypes MNHN 1921.0323–0324 are strikingly different from *T. perroteti* (see Stoll 2008 and Fig. 29) and seem to belong to the elongate, short-legged *T. buettneri* Matschie, 1910/*T. sudanensis* Schmidt, 1919 complex sensu Hoogmoed 1974, which is under review by WB and coworkers).

– *Trachylepis maculilabris* – Chabanaud (1921): Kérouané, Macenta, N'Zébéla, N'Zérékoré, Beyla, Diécké Forest, Sanikolé (as *Mabuya maculilabris*); Angel et al. (1954 a, as *M. Blandingii* and *M. polytropis* (in part.); Grandison (1956): Mt. Nimba (as *Mabuya m. maculilabris*); Böhme (1994 c): Ziama Forest (as *M. maculilabris*); Ineich (2003, as *Euprepis maculilabris*): Mt. Nimba; this paper.

– *Trachylepis perrotetii* – Klaptocz (1913): Conakry, Mamou (as *Mabuia perrotetii*) Chabanaud (1921): Kankan, Beyla (as *M. perrotetii*); Fouta Djallon, Labé/Daralabe mountain, N 11°13'36.9", W 12°16'53.2", photo record, C. Brede.

Fig. 29. Syntypes of *Trachylepis keroanensis* Chabanaud, from Kérouane (MNHN 9121.0323–0324), a valid species of the T. *buettneri/sudanensis* group (Photo: W. Böhme).

– *Trachylepis quinquetaeniata* – Klaptocz (1913): Tinkisso near Dabola (as *Mabuia quinquetaeniata*).

Amphisbaenidae

– *Cynisca* cf. *liberiensis* – Angel et al. (1954 a): Mt. Nimba; this paper: Ziama Forest.

Varanidae

– *Varanus exanthematicus* – Klaptocz (1913): "am Niger"; Greenbaum & Carr (2005): PN Haut Niger.

– *Varanus niloticus* – Chabanaud (1921): everywhere common; Greenbaum & Carr (2005): PN Haut Niger; Hillers et al. (2006): Kolaboui, Rio Kapatchet (Kamsar), Sangarédi; Fouta Djallon, Pita/Hore Binti, N 10°51'04.8", W 12°31'14.1", photo record (Fig. 30) C. Brede.

– *Varanus ornatus* – Chabanaud (1921): the former statement of this author implies this species also to be present in the forest region (as *V. niloticus*); Ineich (2003): Mt. Nimba; Rödel & Bangoura (2004b): Pic de Fon/Simandou range; this paper: Sérédou, Ziama Forest, Diécké Forest.

Leptotyphlopidae

– *Leptotyphlops bicolor* – Trape & Mané (2006): on grid map but without specific locality.

– *Rhinoleptus koniagui* – Trape & Mané (2006): on grid map but without specific locality.

Typhlopidae

– *Typhlops liberiensis* – Mocquard (1902): Kouroussa; Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *T. (p). punctatus*); Roux-Estève (1974): Mt. Nimba (as *T. p. liberiensis*); Böhme (2000): Djani River nr. NZébéla, N'Zérékoré (as *T. p. liberiensis*); Ineich (2003): Mt. Nimba; this paper.

– *Typhlops manni* – Guibé (1952), Angel et al. (1954 b), Ineich (2003): Mt. Nimba. (all three papers refer to the single holotype of *T. angeli* Guibé, 1952 which was synonymyized with *T. manni* by Roux-Estève 1974, see Ineich 2003).

– *Typhlops punctatus* – Chabanaud (1921): N'Zérékoré; Villiers (1950): Dalaba; Condamin (1959): Sérédou; Greenbaum & Carr (2005): PN Haut Niger.

Pythonidae

– *Python regius* – Trape & Mané (2006): on grid map but without specific locality .

– *Python sebae* – Chabanaud (1921): Macenta; Villiers (1954), Angel et al. (1954 b), Ineich (2003: Mt. Nimba; Rödel & Bangoura (2004b): Pic de Fon/Simandou range; Greenbaum & Carr (2005): PN Haut Niger; this paper: Mt. Nimba (Fig.13).

Boidae

– *Calabaria reinhardtii* – Böhme (2000): Sérédou (1st country record); Ineich (2003): Mt. Nimba (Ziéla); this paper.

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Lamprophiidae

– *Bothrophthalmus lineatus* – Chabanaud (1921): N'Zérékoré; Villiers (1954), Angel et al. (1954 b, as *B. l. lineatus*): Mt. Nimba; Condamin (1959): Sérédou; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba (as *B. l. lineatus*); Rödel & Bangoura (2006): Diécké Forest); this paper.

– *Chamaelycus fasciatus* – Chabanaud (1921): N'Zérékoré (as *Lycophidium fasciatum*), Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *Oophilositum fasciatum*); Ineich (2003): Mt. Nimba.

– *Gonionotophis granti* – Trape & Mané (2006 b): on grid map but without specific locality.

– *Gonionotophis klingi* – Villiers (1954), Angel et al. (1954 b), Ineich (2003): Mt. Nimba

– *Hormonotus modestus* – Viliers (1954), Angel et al. (1954 b), Ineich (2003): Mt. Nimba.

– *Lamprophis fuliginosus* – Klaptocz (1913): Konkouré (as *Boodon fuliginosus*); Villiers (1950), Angel et al. (1954 b): Mt. Nimba (as *Boaedon fuliginosus*); Böhme 2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper.

– *Lamprophis lineatus* – Villiers (1950): Mamou (as *Boaedon lineatus*); Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *B. lineatus*); Böhme (2000): Ziama Forest; Ineich: Mt. Nimba; this paper.

– *Lamprophis olivaceus* – Chabanaud (1921): Diécké Forest (as *Boodon olivaceus*); Angel et al. (1954 b): Mt. Nimba (as *Boaedon olivaceus*); Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; Hillers et al. (2006): Rio Kapatchez, Kamsar; this paper.

– *Lamprophis virgatus* – Chabanaud (1921):N'Zébéla, N'Zérékoré (as *Boodon virgatus*); Villiers (1950), Angel et al. (1954 b): Mt. Nimba (as *Boaedon virgatus*); Condamin (1959): Sérédou; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper.

Fig. 30. *Varanus niloticus*, juvenile specimen from the Fouta Djallon range, W Guinea (Photo: C. Brede).

– *Lycophidion albomaculatum* – Trape & Mané (2006 a): on grid map but without specific locality.

– *Lycophidion irroratum* – Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *L. capense* (in part); Trape & Mané (2006): Kindia.

– *Lycophidion nigromaculatum* – Angel et al. (1954 b): Mt. Nimba (as *L. irroratum* (in part)); Ineich (2003): Mt. Nimba.

– *Lycophidion semicinctum* – Villiers (1950), Angel et al. (1954 b): Mt. Nimba; Trape & Mané (2006 b): on grid map but without specific locality.

– *Mehelya crossi* – Trape & Mané (2006 b): on grid map but without specific locality.

– *Mehelya guirali* – Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper.

– *Mehelya poensis* – Chabanaud (1921): near N'Zébéla (as *Simocephalus poensis*); Villiers (1950, 1954), Angel et al. (1954 b): Mt. Nimba; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper.

– *Mehelya stenophthalmus* – Villiers (1954), Angel et al. (1954 b): Mt. Nimba; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper.

Colubridae

– *Bamanophis dorri* – Trape & Baldé (2006): Kalekouré (as *Haemorrhois dorri*); Schätti & Trape (2008): Kalekouré.

– *Crotaphopeltis hippocrepis* – Trape & Mané (2006 b): Kindia.

– *Crotaphopeltis hotamboeia* – Mocquard (1902): Kouroussa (als *Leptodira hotamboeia*); Chabanaud (1921): Macenta, Diécké Forest (as *L. hotamboeia*); Condamin (1959): Sérédou; Böhme (2000): Ziama Forest; Greenbaum & Carr (2005): PN Haut Niger; Trape & Mané (2006 b): Labé; this paper.

– *Dasypeltis confusa* – Greenbaum & Carr (2005): PN Haut Niger (as *D. scabra*); Trape & Mané (2006 a): Kilissi, Kouroumaya, Kalekouré, Foulaya, Friguiagbé, Camarabunyi, Seffan, Madina, Hamdalaye, Sankalabadou, Dalakan.

– *Dasypeltis gansi* – Trape & Mané (2006 a, b): on grid map but without specific locality, despite all (but only non-Guinean) localities listed in Trape & Mané (2006 a).

– *Dasypeltis fasciata* – Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; Trape & Mané (2006 a): this paper.

– *Dasypeltis* cf. *scabra* – Mocquard (1902): Kouroussa; Ineich (2003) and this paper: Mt. Nimba; Trape & Mané (2006 a): Dalakan.

– *Dipsadoboa brevirostris* – Chabanaud (1921): N'Zérékoré, Diécké Forest (as *Leptodira guineensis*); Rödel & Bangoura (2006): Mt. Béro; Hillers et al. (2006): Sangarédi; this paper.

– *Dipsadoboa* sp.? – Mocquard (1902): Kouroussa (as *L. pobeguini*).

– *Dipsadoboa underwoodi* – Angel et al. (1954 b): Mt. Nimba (as *D. unicolor*); Rasmussen (1993), Ineich (2003): Mt. Nimba.

– *Dipsadoboa unicolor* – Klaptocz (1913): Mamou; Chabanaud (1921): Macenta, N'Zéréjoré; Villiers (1950): Dalaba; Villiers

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(1954), Angel et al. (1954 b): Mt. Nimba; Böhme (1994 a): Ziama Forest; Ineich (2003): Mt. Nimba; Rödel & Bangoura (2006): Diécké Forest; this paper.

– *Dipsadoboa viridis* – Villiers 1954), Angel et al. (1954 b): Mt. Nimba (as *D. elongata*); Ineich (2003): Mt. Nimba.

– *Dipsadoboa weileri* – Angel et al. (1954 b): Mt. Nimba (as *D. unicolor* (part)); Ineich (2003): Mt. Nimba.

– *Dispholidus typus* – Chabanaud (1921): N'Zébéla; Villiers (1950): Dalaba; Ineich (2003): Mt. Nimba; Trape & Mané (2006 b): Kindia.

– *Hapsidophrys smaragdina* – Chabanaud (1921): Macenta, N'Zérékoré (as *Gastropyxis smaragdina*) Condamin (1959): Sérédou (as *G. smaragdina*); Böhme (2000): Ziama Forest (as *G. smaragdina*); this paper.

– *Hapsidophrys lineata* – Chabanaud (1921): N'Zébéla, Diécké; Angel et al. (1954 b), Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper.

– *Meizodon coronatus* – Mocquard (1902): Koroussa (als *Coronella coronata*); Villiers (1950): Dalaba; Condamin (1959): Sérédou; Roux-Estève (1969): Sambailo, Kouroussa; Böhme (2000): N'Zérékoré; Greenbaum & Carr (2005): PN Haut Niger.

– *Meizodon regularis* – Angel et al. (1954 b) Mt. Nimba (as *M. coronatus* (? in part); Roux-Estève (1969): Kérouané, Beyla, Fouta Djallon, Dalaba, Coyah, Sérédou, Mt. Nimba; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper.

– *Philothamnus carinatus* – Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *P. heterodermus carinatus*); Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper.

– *Philothamnus heterodermus* – Chabanaud (1921): N'Zébéla (as *Chlorophis heterodermus*); Villiers (1950): Mt. Nimba (as *C. heterodermus*); Villiers (1954), Angel et al. (1954): Mt. Nimba (as *P. h. heterodermus*); Greenbaum & Carr (2005): PN Haut Niger; Rödel & Bangoura (2006): Mt. Béro; this paper.

– *Philothamnus irregularis* – Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *P. i. irregularis)*; Ineich (2003): Mt. Nimba; Rödel & Bangoura (2004b): Pic de Fon/Simandou range; Greenbaum & Carr (2005): PN Haut Niger; this paper.

– *Philothamnus semivariegatus* – Klaptocz (1913): Dubreka; Condamin (1959): Sérédou.

– *Telescopus variegatus* – Greenbaum & Carr (2005): PN Haut Niger.

– *Thelotornis kirtlandii* – Villiers (1950), Angel et al. (1954 b), Ineich (2003): Mt. Nimba; Riquier & Böhme (1996): Ziama Forest; Ineich (2003): Mt. Nimba; Rödel & Bangoura (2006): Diécké Forest; this paper.

– *Thrasops occidentalis* – Villiers (1950): Dalaba; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; Trape & Mané (2006): N'Zérékoré; this paper.

– *Toxicodryas blandingii* – Chabanaud (1921): Macenta, N'Zébéla, Diécké Forest (as *Dipsadomorphus blandingii*) Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *Boiga blandingii*; Condamin (1959): Sérédou (as *B. blandingii*); Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba (as *B. blandingii*); Greenbaum & Carr (2005): PN Haut Niger; Trape & Mané (2006): N'Zérékoré; this paper; Mt. Nimba, this paper.

– *Toxicodryas pulverulentus* – Chabanaud (1921): Macenta (as *Dipsadomorphus pulverulentus*); Villiers (1954), Angel et al. (1954 b), Ineich (2003): Diécké Forest; Mt. Nimba (as *Boiga pulverulenta*); this paper: east of Guéckédou, Ziama Forest.

Natricidae

– *Afronatrix anoscopus* – Boulenger (1910): Labé (as *Helicops gendrii* sp. n.); Klaptocz (1913): Mamou (as *Tropidonotus ferox*); Chabanaud (1921): Macenta, N'Zébéla, N'Zérékoré (as *T. ferox*); Villiers (1950): Dalaba, Mt. Nimba (as *Natrix anoscopus gendrii*); Villiers (1954): Mt. Nimba (as *N. anoscopus*); Condamin (1959): Sérédou (as *N. anoscopus*); Böhme (2000): Ziama and Diécké Forests; Ineich (2003: Mt. Nimba); Rödel & Bangoura (2004b): Pic de Fon/Simandou range; Rödel & Bangoura (2006): Diécké Forest; this paper; Pic de Fon/Simandou range (Rödel & Bangoura 2004b), this paper.

– *Amblyodipsas unicolor* – Trape & Mané (2006): on grid map but without specific locality.

– *Grayia smithii* – Klaptocz (1913): Dabola; Chabanaud (1921): N'Zébéla. N'Zérékoré; Villiers (1950): Mt. Nimba; Condamin (1959): Sérédou; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; Greenbaum & Carr (2005): PN Haut Niger; Trape & Mané (2005): Djani River; this paper.

– *Grayia tholloni* – Trape & Mané (2006 b): on grid map but without specific locality.

– *Natriciteres variegata* – Mocquard (1902): Kouroussa (als *Mizodon variegatus*); Chabanaud (1921): Macenta, N'Zébéla, N'Zérékoré (as *Tropidonotus variegatus*); Villiers (1950, 1954), Angel et al. (1954 b): Mt. Nimba (as *Neusterophis variegatus*); Condamin (1959): Sérédou (as *Neusterophis variegatus*); Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; Greenbaum & Carr (2005) PN Haut Niger; Trape & Mané (2006): N'Zérékoré.

Psammophiidae

– *Psammophis lineatus* – Villiers (1950): Dalaba; Trape & Mané (2006 b): Kindia.

– *Psammophis praeornatus* – Mocquard (1902): Kouroussa; Greenbaum & Carr (2005): PN Haut Niger.

– *Psammophis elegans* – Greenbaum & Carr (2005): PN Haut Niger.

– *Psammophis* cf. *phillipsi* – Mocquard (1902): Kouroussa (as *P. sibilans*); Klaptocz (1913): Dubreka (as *P. sibilans*); Chabanaud (1921): Macenta, N'Zébéla, N'Zérékoré, Diécké Forest (as *P. sibilans*); Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *P. sibilans phillipsii*); Brandstätter (1996), Ineich (2003): Mt. Nimba; this paper (Kissidougou).

– *Psammophis phillipsi* – Villiers (1950, 1954), Angel et al. (1954 b): Mt. Nimba (as *P. sibilans phillipsii*); Condamin (1950): Sérédou (as *P. sibilans phillipsii*); this paper.

– *Rhamphiophis oxyrhynchus* – Trape & Mané (2006): on grid map, but without specific locality.

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Atractaspididae

– *Aparallactus lineatus* – Villiers (1950, 1954), Angel et al. (1954 b), Wallach (1994): Mt. Nimba; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; this paper: Ziama Forest.

– *Aparallactus modestus* – Condamin (1959): Sérédou; Ineich (2003): Mt. Nimba; Rödel & Bangoura (2006): Diécké; this paper.

– *Aparallactus niger* – Chabanaud (1917): Sampouyara (as *Rouleophis chevalieri*); Chabanaud (1921): Kérouane, Beyla, N'Zérékore, Diécké Forest; Villiers (1950): Dalaba; Angel et al. (1954 b): Mt. Nimba; Condamin (1959): Sérédou; Wallach (1994): Mt. Nimba; Ineich (2003): Mt. Nimba; this paper.

– *Atractaspis irregularis* – Condamin (1959): Sérédou; this paper.

– *Atractaspis aterrima* – Mocquard (1906): Conakry; Chabanaud (1921): Dixine; Rasmussen (2005): Mt. Nimba; Trape & Mané (2006 b): on grid map but without specific localities. Not listed by Ineich (2003).

– *Polemon acanthias* – Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *Miodon acanthias*); Condamin (1959): Sérédou (as *M. acanthias*); Ineich (2003): Mt. Nimba; this paper: Ziama Forest.

– *Polemon bocourti* – Angel et al. (1954): Mt. Nimba (but not mentioned by Ineich (2003).

– *Prosymna greigerti* – Trape & Mané (2006): on grid map but without specific locality.

– *Prosymna meleagris* – Trape & Mané (2006): on grid map but without specific locality.

Elapidae

– *Dendroaspis polylepis* – Greenbaum et al. (2003): PN Haut Niger; Trape & Mané (2006): Kindia.

– *Dendroaspis viridis* – Klaptocz (1913): Konkouré; Chabanauid (1921): N'Zébéla, N'Zérékoré; Villiers (1950), Angel et al. (1954 b): Mt. Nimba; Condamin (1959): Sérédou; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; Greenbaum et Carr (2005): PN Haut Niger; Trape & Mané (2006): Kindia; this paper.

– *Elapsoidea semiannulata* – Greenbaum & Carr (2005): PN Haut Niger.

– *Elapsoidea trapei* – Trape & Mané (2006): on grid map but without specific locality. – Note: We are not yet fully convinced of the taxonomic distinctness of this species.

– *Naja haje* – Trape & Mané (2006): on grid map but without specific locality.

– *Naja katiensis* – Trape & Mané (2006): on grid map but without specific locality.

– *Naja melanoleuca* – Chabanaud (1921): Macenta, N'Zébéla, N'Zérékoré; Villiers (1950), Angel et al. (1954 b): Diécké Forest, Mt. Nimba; Condamin (1959), Böhme (2000): Sérédou; Ineich (2003): Diécké Forest, Mt. Nimba; Rödel & Bangoura 2004b): Pic de Fon/Simandou range; Rödel & Bangoura (2006): Diécké Forest; Trape & Mané (2006): Kindia; this paper.

– *Naja nigricollis* – Mocquard (1902): Kouroussa; Villiers (1950), Angel et al. (1954 b): Mt. Nimba; Condamin (1959): Sérédou; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; Rödel & Bangoura (2004b): Pic de Fon/Simandou range; Greenbaum & Carr (2005): PN Haut Niger; Rödel & Bangoura (2006): Mt. Béro; this paper.

– *Pseudohaje nigra* – Roman (1976): N'Zérékoré; Böhme (2000): Diécké Forest; this paper.

Viperidae

– *Atheris chlorechis* – Chabanaud (1921): Macenta; Villiers (1950), Angel et al. (1954 b): Mt. Nimba; Condamin (1959): Sérédou; Böhme (2000): Ziama Forest; Ineich (2003): Mt. Nimba; Rödel & Bangoura (2006): Déré Forest; this paper: Mt. Nimba, photo record C. Brede.

– *Bitis arietans* – Klaptocz (1913): "Kampement am Niger"; Rödel & Bangoura (2004b): Pic de Fon/Simandou range; Greenbaum & Carr (2005): PN Haut Niger; Hillers et al. (2006): Rio Kapatchez, Kamsar; this paper: Kissidougou.

– *Bitis nasicornis* – Chabanaud (1921): Macenta, N'Zébéla, N'Zérékoré; Villiers (1954), Angel et al. (1954 b): Mt. Nimba; Condamin (1959): Sérédou; Böhme (2000): Ziama and Diécké Forests, this paper; Ineich (2003): Mt. Nimba; this paper.

– *Bitis rhinoceros* – Chabanaud (1921): Macenta, N'Zérékoré, Diécké Forest (as *B. gabonica*); Villiers (1950): Dalaba (as *B. gabonica*); Villiers (1954), Angel et al. (1954 b): Mt. Nimba (as *B. gabonica*); Condamin (1959): Sérédou (as *B. g. rhinoceros*); Greenbaum & Carr (2005): PN Haut Niger (as *B. gabonica*); Böhme (2000): between Macenta and Sérédou, Diécké Forest (as *B. gabonica*); Ineich (2003): Mt. Nimba; Rödel & Bangoura (2004b): Pic de Fon/Simandou range (as *B. gabonica*); Rödel & Bangoura (2006): Fouta Djallon, Labé/Daralabe/Forêt Kokoulo; this paper.

– *Causus lichtensteinii* – Condamin (1959): Sérédou; Ineich (2003): Mt. Nimba.

– *Causus maculatus* – Mocquard (1902): Kouroussa (as *C. rhombeatus*); Chabanaud (1921): Macenta, N'Zébéla; N'Zérékoré, Diécké Forest (as *C. rhombeatus*); Villiers (1950): Dalaba, Mamou, Mt. Nimba (as *C. rhombeatus*); Angel et al. (1954 b): Mt. Nimba (as *C. rhombeatus*); Böhme (2000): Ziama and Diécké Forests; Ineich (2003): Mt. Nimba; Greenbaum & Carr (2005): PN Haut Niger; Hillers et al. (2006): Kolaboui; Rödel & Bangoura (2006): Deéré Forest; Trape & Mané (2006): N'Zérékoré; this paper.

– *Echis ocellatus* – Trape & Mané (2006): on grid map, but without specific locality.

Crocodylidae

– *Crocodylus suchus* – Klaptocz (1913): Mamou, Konkouré N of Dubreka (as *C. niloticus*) Greenbaum & Carr (2005): PN Haut Niger (as *C. niloticus*).

– *Mecistops cataphractus* – Klaptocz (1913): Baffing (reported to him as "Krokodil mit spitzer Schnauze"; Chabanaud (1921): Kérouané (as *Crocodylus ctataphractus*; Greenbaum & Carr (2005): PN Haut Niger (as *C. cataphractus*).

– *Osteolaemus tetraspis* – Chabanaud (1921): Kérouané, N'Zébéla; Rödel & Bangoura (2004b): Pic de Fon/Simandou range; Rödel & Bangoura (2006): Diécké Forest; this paper.

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Appendix II

List of the fish species collected in Ziama Forest

Along with the few fish specimens recovered from the stomachs of the (semi)aquatic snake species *Afronatrix anoscopus* and *Grayia smithii* (see above), some more fishes were collected on the occasion of the herpetological survey. They have been identified by Dr. Jörg Freyhof (formerly ZFMK Bonn, now Berlin) and are deposited in the ZFMK ichthyological collection:

Mormyridae
Petrocephalus tenuicaudatus (Steindachner, 1899)

Citharinidae
Neolebias unifasciatus Steindachner, 1894

Cyprinidae
Barbus cf. *traorei* Lévèque, Tengels & Thys, 1987
Kribia cf. *nana* (aus *Afronatrix anoscopus* ZFMK 56076)

Schilbeidae
Schilbe mandibularis (Günther, 1867)

Amphiliidae
Amphilius rheophilus Daget, 1959

Clariidae
Heterobranchus longifilis Valenciennes, 1840

Mochokidae (Synodontidae)
Chiloglanis occidentalis Pellegrin, 1933
Synodontus sp. (cf. *comoensis*?)

Aplocheilidae
Epiplatys olbrechtsi Poll, 1941
Epiplatys lamottei Daget, 1954

Cyprinodontidae
Aplocheilichthys schioetzi Scheel, 1968 (aus *Afronatrix anoscopus* ZFMK 56066 and 56275)
Aplocheilichthys normani Ahl, 1928

Cichlidae
Tilapia (Coptodon) sp. n. ? (aus *Grayia smithii* ZFMK 56036)

Mastacembelidae
Aethiomastacembelus liberiensis (Boulenger, 1898).

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A new record of the Persian Brook Salamander, *Paradactylodon persicus* (Eiselt & Steiner, 1970) (Amphibia: Caudata: Hynobiidae) in northern Iran

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INTRODUCTION

The Persian Brook Salamander, *Paradactylodon persicus* (Eiselt & Steiner, 1970) is an endemic and poorly known species of northern Iran (Baloutch & Kami 1995; Kami 1999). It was originally described as *Batrachuperus persicus* by Eiselt & Steiner (1970), but has been transferred to the genus *Paradactylodon* based on genetic studies by Zhang et al. (2006). This species has been reported from two localities only: Weyser, southeast of Chalus, in Mazandaran Province (36° 30′ 35" N and 51° 26′ 38" E) and Delmadeh village, southeast of Khalkhal, in Ardabil Province (37° 22′ 34" N and 48° 47′ 35" E) (Kami 2004; Ebrahimi et al., 2004) (Fig. 1). Here, we report a new record of this species in Hyrcanian forest, in Gilan Province, Iran.

RESULTS

During our field survey in June 2010, a single specimen was collected in Dasht-e-Daman Yeylagi, in Rezvan Shahr city of Gilan Province (37° 27' 53" N and 48° 47' 10" E) at an elevation of 1622 m a. s. l. (Fig. 1). This specimen is a subadult (Fig. 2a–b) and it was identified as *Paradactylodon persicus* based on external morphological characters which mentioned by Baloutch & Kami (1995). Because this is a threatened species in Iran (Papenfuss et al. 2011; Ahmadzadeh & Kami 2009), it was released into the natural habitat after morphological examination. The characteristic features of this specimen are as the following: total length 23 mm; snout-vent length 90 mm; tail length 120 mm; head large, 20 mm in length; vomerine teeth in two arch-shaped rows; snout rounded; fore and hind limbs with four digits; tail flattened laterally, with round-tapered end; dorsal head and body, as well as upper surface of tail brownish with yellow spots and marblings; belly cream without pattern (Fig. 2a–b).

Paradactylodon persicus inhabits the mountainous streams and brooks, with cool, fast-flowing water (Baloutch & Kami 1995; Kami 1999; Ahmadzadeh & Kami 2009). Like the Delmadeh habitat in Ardabil Province, the habitat reported here is also located in a non-forestry area (Ahmadzadeh & Kami 2009). The specimen was found under a stone close by a stream on the steep slope of Alborz Mountains, exposed to the Caspian Sea.

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Fig. 1. Map showing the two former valid localities and new reported locality of *Paradactylodon persicus* in Iran.

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Fig. 2a–b. *Paradactylodon persicus* from Dasht-e-Daman Yeylagi in Rezvan Shahr city of Gilan Province.

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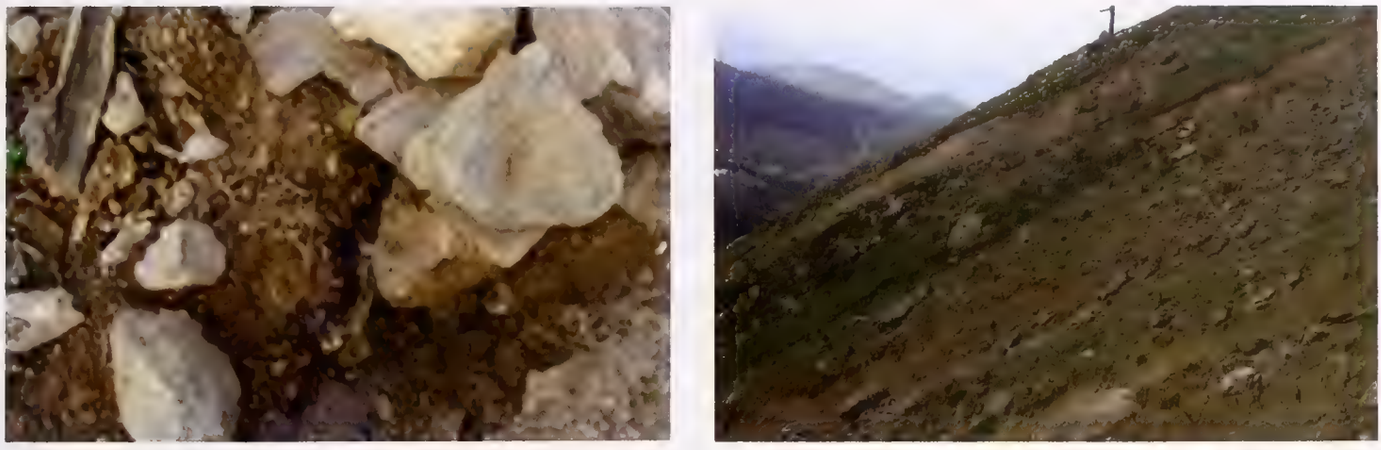

Fig. 3a–b. The newly recorded habitat of *Paradactylodon persicus* in the Dasht-e-Daman Yeylagi in Rezvan Shahr city of Gilan Province.

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Type list of amphibians and reptiles in the Zoologisches Forschungsmuseum A. Koenig, Bonn: corrections and additions

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The last issue of this journal contained type catalogues of the vertebrate collections in the Zoologisches Forschungsmuseum A. Koenig (ZFMK) in Bonn, among them that of the amphibians and reptiles. It was already earlier and still is my plan to publish an extensive, comprehensive and critically commented herpetological type catalogue after my nearly four decades of curatorship at ZFMK, together with a new, illustrated overview of the history of the Bonn collection, of all herpetological activities in Bonn at ZFMK and the time before (Böhme in prep. 2011). Therefore I hesitated to take also part in the joint catalogue project of the museum, since I was afraid of redundancies between both publication projects. I became, however, convinced that herpetology should not be missing among the catalogues of mammals, birds and fishes, and so I decided for a compromise which could be accomplished in a relatively short time without delaying the time schedule of the entire issue too much: A reduced list giving only

– name, author and year of description;

– catalogue numbers only for name bearers in ZFMK; for name bearers in other collections and for typoids only the acronym of the respective collections;

– country of origin and current name if the original name had changed since the original description, either by different generic assignments or by synonymizations. The reader was already referred to the extensive catalogue with all specimen data including figures to follow in 2011 (Böhme 2010: Bonn zoological Bulletin 59: 79–108).

Unfortunately, the time pressure which arose from the above-mentioned circumstances led to some errors and misprints which escaped our attention during proofreading. Such mistakes are particularly annoying when scientific names are concerned because a misspelled name is a different combination of letters and thus a different (mostly nude) name in the sense of the Code (ICZN 1999), and the need to correct them is obvious. I prefer to provide such an errata list myself before it has to or will be done by collegues, but I will not consider matters which are dependant from opinions (e.g. assignments to suprageneric categories etc.). Rather, I shall correct only those mistakes (misspellings, omissions) which may affect nomenclature, authorships, dates of publication, or places of deposition. For the institutional abbreviations the reader is referred to the first type list cited above.

In order to make this paper a little bit more than just an errata sheet for the published type list, I take also the opportunity to add several taxa recently published and not yet contained in the list. These are marked **in bold**, as are the corrections (followed by the erroneous names, words or acronyms in parentheses; otherwise they are additions). Corrections are listed in the order of taxa as published in the type list. The newly described taxa are –**in bold** – included in this systematic order. New, further acronyms are **AMS**: Australian Museum, Sydney; **CRES**: Center for Natural Resources and Environmental Studies, Hanoi (= VNUH) ; **NCSM**: North Carolina Museum of Natural Sciences, Raleigh; and **SNHM-BS**: State Natural History Museum, Braunschweig.

AMPHIBIA

Pelodryadidae (not Pelodrydaidae)

Hemiphractidae (not Amphignathodontidae)

Gastrotheca piperata Duellman & J. Köhler, 2005
Holotype: ZFMK 66838, paratypes in ZFMK **and KU**
Origin: Bolivia

Hylidae

Osteocephalus oophagus Jungfer & Schiesari, 1995
Paratypes in ZFMK, NMW, MPEG, AMNH, MZUSP, INPA and SMNS, **holotype in MZUSP**

Centrolenidae

Hyalinobatrachium carlesvilai Castroviejo-Fisher, Padial, Chaparro, Aguayo & De la Riva, 2009
Paratypes in ZFMK, **CBG**, MHNC and MNHN, holotype in **MHNCP** (not in MNHN)
Origin: Bolivia

Strabomantidae

Eleutherodactylus olivaceus J. Köhler, Morales, Lötters, Reichle & Aparicio, 1998
Paratypes in ZFMK, CBF, MUSM and USNM, **holotype in CBF**
Origin: Bolivia
Current name: *Pristimantis olivaceus*

Pristimantis koehleri Padial & De la Riva, 2009
Paratypes in ZFMK, MNCN and NMK, holotype in **NKA** (not MNCN)
Origin: Bolivia

Pristimantis reichlei Padial & De la Riva, 2009
Paratypes in ZFMK, **CBG, KU**, MNCN, **NMP6V, NMW, USNM** and NMK, holotype in **NKA**
Origin: Bolivia

Leptodactylidae

Adenomera griseigularis Henle, 1981
Holotype: ZFMK 31800, no paratypes
Origin: Peru
Current name *Leptodactylus* ***griseigularis*** (not *griseonotus*)

Leptodactylus raniformis Werner, 1899
Holotype: ZFMK **28484** (not 80600), no paratypes
Origin: Colombia
Current name: *Leptodactylus fuscus*.

Ceratophryidae

Telmatobius mayoloi Salas & Sinsch, 1996
Paratypes in ZFMK, URP, MHNSM and KU, holotype in URP
Origin: **Peru** (not Bolivia)

Dendrobatidae

Dendrobates typographus Keferstein, 1867
Holotype: **ZFMK** 28115, no paratypes
Origin: Costa Rica
Current name: ***Oophaga*** (not *-gus*) *pumilio*

Epipedobates bilinguis Jungfer, 1989
Holotype: ZFMK49073, paratypes in ZFMK
Origin: Ecuador
Current name: ***Ameerega*** (not *Amereega*) *bilinguis*.

Bufonidae

Atelopus cruciger vogli L. Müller, 1935
Paratypes in ZFMK, **HLMD** and ZSM, holotype in ZSM.
Origin: Venezuela
Current name: *Atelopus vogli*

Atelopus flaviventris Werner, 1899
Holotype: ZFMK 28107, no paratypes
Origin: Colombia
Current name: *Atelopus* ***subornatus*** (not *ignescens*)

Bufo scorteccii Balletto & Cherchi, 1970
Paratypes in ZFMK and IZUG, holotype in IZUG
Origin: Yemen
Current name: *Duttaphrynus scorteccii*

Werneria submontana **Rödel, Schmitz, Pauwels, & Böhme, 2004**
Holotype: ZFMK 69999, paratypes in ZFMK
Origin: Cameroon

Microhylidae

Plethodontohyla ***mihanika*** (not *mikanika*) Vences, Raxworthy, Nussbaum & Glaw, 2003
Paratypes in ZFMK, ZSM, UMMZ and MNHN, holotype in UMMZ
Origin: Madagascar

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Hyperoliidae

Heterixalus ***andrakata*** (not *mandrakata*) Glaw & Vences, 1991
Holotype: ZFMK 52557, paratypes in ZFMK and ZSM
Origin: Madagascar

Arthroleptidae

Leptodactylodon wildi **Amiet** (not Amit) & Dowsett-Lemaire, 2000
Paratypes ZFMK, MNHN and BMNH, holotype in MNHN
Origin: Cameroon

Phrynobatrachus nlonakoensis **Plath, Herrmann & Böhme, 2006**
Holotype: ZFMK 80970, paratypes in ZFMK
Origin: Cameroon
Current name: *Arthroleptis nlonakoensis*

Phrynobatrachidae

Phrynobatrachus kakamikro Schick, Zimkus, Channing, J. Köhler & Lötters, 2010
Paratypes in ZFMK **and NMK** (not in BMNH and NKM), holotype in **NMK** (not NKM)
Origin: W Kenya

Mantellidae

Blommersia galani Vences, J. Köhler, Pabijan & Glaw, 2010
Paratypes: in ZFMK, ZMA and ZSM, **holotype in ZSM**
Origin: Madagascar
Current name: ***Boophis occidentalis***

Boophis blommersae Glaw & Vences **1994** (not 1995)
Holotype: ZFMK 57398, paratypes in ZFMK and ZSM
Origin: Madagascar

Boophis haingana Glaw, J. Köhler, De la Riva, Vietes **& Vences**, 2010
Paratypes in ZFMK, ZSM and UADBA, holotype in ZSM
Origin: Madagascar

Boophis luciae Glaw, J. Köhler, De la Riva, Vieites **& Vences**, 2010
Paratypes in ZFMK, ZSM and UADBA, holotype in ZSM
Origin: Madagascar

***Boophis quasiboehmei* Vences, J. Köhler, Crottini & Glaw, 2010**
Paratypes in ZFMK and ZSM, holotype in ZSM
Origin: Madagascar

Boophis tampoka J. Köhler, Glaw & Vences, 2007
Paratypes in ZFMK, HLMD, UADBA and ZSM **(not in FGZC)**, holotype in ZSM
Origin: Madagascar

Mantella expectata Busse & Böhme, 1992
Holotype: ZFMK, paratypes in ZFMK **and ZSM**
Origin: Madagascar

Mantidactylus corvus Glaw & Vences, **1994** (not 1992)
Holotype: ZFMK 57430, paratypes in ZFMK and ZSM
Origin: Madagascar
Current name: *Gephyromantis (Phylacomantis) corvus*

Rhacophoridae

Philautus quyeti Nguyen Q.T., Hendrix, Böhme, Vu & Ziegler, 2008
Holotype: ZFMK 82999, paratype in VNUH
Origin: Vietnam
Current name: ***Gracixalus quyeti***

Rhacophorus orlovi Ziegler & J.Köhler, 2001
Holotype: ZFMK 71368, paratypes in **ZFMK** (not ZMFK), MTKD, CRES and ZMB
Origin: Vietnam

***Rhacophorus vampyrus* Rowley, Le, Tran, Stuart & Hoang, 2010**
Paratypes in ZFMK, AMS, UNS, NCSM, holotype in AMS
Origin: Vietnam

Ranidae

Rana balcanica H. Schneider, Sinsch & Sofianidou, 1993
Holotype: ZFMK 52825, paratypes in ZFMK
Origin: Greece
Current name: *Pelophylax* ***kurtmuelleri*** (not *kurtklari*)

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Agamidae

Agama pakistanica Baig, 1989
Paratypes in ZFMK and PMNH, **holotype in PMNH**
Origin: N Pakistan
Current name: *Laudakia pakistanica*

Calotes nigriplicatus Hallermann, 2001 ("2000")
Holotype: **ZFMK** 26379, no paratypes
Origin: Moluccas, Indonesia

Pseudocalotes ziegleri Hallermann, Nguyen Q.T., Orlov & Ananjeva, 2010
Paratypes in ZFMK, IEBR and ZISP, holotype **in IEBR**
Origin: Vietnam

Chamaeleonidae

Bradypodion tavetanum boehmei Lutzmann & Nečas, 2002
Holotype: **ZFMK** 63373, paratypes in ZFMK
Origin: Kenya
Current name: *Kinyongia boehmei*

Chamaeleo marsabitensis Tilbury, 1991
Paratypes in ZFMK and BMNH, **holotype in BMNH**
Origin: N Kenya
Current name: *Trioceros marsabitensis*.

***Kinyongia uthmoelleri artytor* Lutzmann, Stipala, Lademann, Krause, Wilms & Schmitz, 2010**
Paratypes in ZFMK and MHNG, holotype in MHNG
Origin: Tanzania

Phyllodactylidae

Gecko fascicularis Daudin, 1802
Neotype: ZFMK 35631
Origin: Libya
Current name: ***Tarentola f. fascicularis*** (not *T. mauritanica fascicularis*)

***Tarentola fascicularis wolfgangi* Joger & Bshaenia, 2010**
Paratypes in ZFMK, HLMD and SNHM-BS, holotype in SNHM-BS
Origin: Tunisia

Sphaerodactylidae

Pristurus obsti Rösler & Wranik, 1999
Paratypes in ZFMK, MTKD, HLMD and pers. coll. H.R., **holotype in MTKD**
Origin: Socotra Id., Yemen

Gekkonidae

Cyrtodactylus cattienensis Geißler, Nazarov, Orlov, Böhme, **Phung** (not Trung), Nguyen Q.T. & Ziegler, 2009
Paratypes in ZFMK IEBR, VNUH, ZMMU and ZISP, holotype in IEBR
Origin: Vietnam

Cyrtodactylus phongnhakebangensis Ziegler, Rösler, H.W. Herrmann & **Vu** (not Thanh), 2003 ("2002")
Holotype: ZFMK 76193, paratypes in ZFMK, VNUH and MTKD
Origin: Vietnam

Gekko siamensis Grossmann & Ulber, 1990
Paratypes in ZFMK, MTKD and pers. coll. W.G., **holotype in MTKD**
Origin: Thailand

Gekko scientiadventura Rösler, Ziegler, **Vu** (not Thanh), H.W. Herrmann & Böhme (2005 ("2004")
Holotype: ZFMK 76198, paratypes in ZFMK and VNUH
Origin: Vietnam

***Hemiphyllodactylus titiwangsaensis* Zug, 2010**
Paratypes in ZFMK and ZRC, holotype in ZRC
Origin: Malaysia

Pachydactylus capensis katanganus De Witte, 1953
Paratypes in ZFMK and IRSN**B, holotype in IRSNB**
Origin: D.R. Congo

Lacertidae

Lacerta cappadocica muhtari Eiselt, 1979
Paratypes in ZFMK, SZE, NMW, ZSM, ZMH, BMNH, FMNH and CAS, **holotype in NMW**
Origin: Turkey
Current name *Apathya cappadocica muhtari*.

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Scincidae

Ablepharus chernovi eiselti Schmidtler, 1997
Paratypes in ZFMK, ZSM, ZDEU and NMW, **holotype in ZSM**
Origin: S Turkey

Varanidae

Varanus rasmusseni Koch, Gaulke & Böhme, 2010
Paratype in ZFMK, holotype in ZMUC
Origin: Tawi Tawi **Id.** (not UID.), Sulu Ids., Indonesia

Calamariidae

*Calamaria **thanhi*** (not thani) Ziegler & Le, 2005
Holotype: ZFMK 82920, no paratypes
Origin: Vietnam

Colubridae

Lycodon ruhstrati abditus Vogel, David, Pauwels, Sumontha, Norval, Hendrix, Vu & Ziegler, 2009
Holotype: ZFMK **86451**, paratypes in ZFMK, MNHN and ZMB
Origin: Vietnam

Viperidae: Crotalinae

Trimeresurus nebularis Vogel, David & Pauwels, 2001
Paratypes in ZFMK, IRSNB, MNHN, ZRC and Coll. G. Vogel, **holotype in USNM**
Origin: Thailand

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Paulsen MJ (2010) The Stag Beetles of Southern South America (Coleoptera: Lucanidae). Bulletin of the University of Nebraska State Museum Vol. 24: 148pp. 130 illus. + 29 maps. Gail Littrell, Publications Secretary, W436 Nebraska Hall, University of Nebraska, Lincoln, NE 68588-0514, U.S.A. E-mail: littrell@unlserve.unl.edu. FAX: (402) 472-8949.$40.

Matt's book is a monographic compilation of original and recent research on southern South American stag beetles (Coleoptera: Scarabaeoidea: Lucanidae) which includes their taxonomic treatment, the study of their distribution but involves also the phylogenetic analysis of a selected genus, *Pycnosiphorus*. It was part of a research project that funded by the National Science Foundation (NSF)-PEET (Partnerships for Enhancing Expertise in Taxonomy; e.g. http://www-museum.unl.edu/research/entomology/PEET2Summary.htm) and which have produced a series of monographs and other taxonomic works but also attractive web sites. The endemic stag beetle fauna of the study area includes 31 species in three subfamilies. The author provides keys to species and genera of southern South American Lucanidae and updates information on genera that have been recently revised. All species are redescribed and keys are provided in English and Spanish when appropriate. The high quality images of male genitalia and habitus of species makes the book a MUST for South American Coleopterists but also aesthetically very nice. Distribution information presented by detailed maps is completed also by the knowledge of species phenology. In the context of the taxonomic treatment he discusses the systematic position of the monogeneric tribe Streptocerini Kikuta, 1986 which he placed into synonymy with Lamprimini.

The monograph concludes with an interesting appendix which represents a first molecular study of southern South American Lucanidae, namely on the genus *Pycnosiphorus,* using DNA of the 28s D2 region and ITS2 with a number of ca. 1500 base pairs. Although the sampling of the group was complete the author dedicated only little space for this analysis in regard of methodological details but also the discussion of the interesting results which would have been very exciting also for a more generally interested reader. In the meantime the produced sequence data were submitted to Genbank and though they can be extended or used in future molecular work by colleagues what makes the work are an even more valuable piece in the mosaic of beetle biodiversity exploration.

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Aphyosemion musafirii (Cyprinodontiformes: Nothobranchiidae), a new species from the Tshopo Province in the Democratic Republic of Congo, with some notes on the *Aphyosemion* of the Congo Basin

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Abstract. *Aphyosemion musafirii*, new species, is described from specimens collected near Ubundu (Ruiki River, Congo Basin, Tshopo Province, Democratic Republic of the Congo). Another population of *A. musafirii* is known from the Romée River, 50 km West of Kisangani. The Ruiki and Romée Rivers are small tributaries on the left bank of the Congo River. *Aphyosemion musafirii* can be distinguished from its closest relative *A. castaneum* by the male colour pattern. A preliminary DNA analysis demonstrates that *Aphyosemion* s.s. consists of two major clades. *Aphyosemion musafirii* is in a clade with *A. castaneum*, *A. polli*, *A. lamberti*, *A. rectogoense,* and *A. congicum*. The distribution of all species of *Aphyosemion* s.s. is discussed.

Resumé. *Aphyosemion musafirii*, nouvelle espèce, est décrite à partir de spécimens récoltés près de Ubundu (rivière Ruiki, bassin du Congo, Province Tshopo, République Démocratique du Congo). Une autre population de *A. musafirii* est connue de la rivière Romée, 50 km à l'Ouest de Kisangani. Les rivières Ruiki et Romée sont de petits affluents rive gauche du fleuve Congo. *Aphyosemion musafirii* peut être distingué de son plus proche parent *A. castaneum* par le patron de coloration mâle. Une analyse ADN préliminaire démontre que *Aphyosemion s.s.* consiste en 2 clades majeurs. *Aphyosemion musafirii* est dans un clade avec *A. castaneum*, *A. polli*, *A. lamberti*, *A. rectogoense* et *A. congicum*. La distribution de toutes les espèces de *Aphyosemion s.s.* est discutée.

Key words. Killifish, eastern Congo basin, Ubundu, systematics, taxonomy, biogeography.

INTRODUCTION

The genus *Aphyosemion* was erected by Myers in 1924 with the type species *A. castaneum*, described in the same publication, from Kisangani (Democratic Republic of Congo). At present the taxonomy of the genus is still not settled, here we use *Aphyosemion* as proposed in two recent publications of the authors (Sonnenberg, 2007; Van der Zee & Sonnenberg, 2010). This is identical with the subgenus *Aphyosemion* of other authors (e.g. Collier, 2007; Huber, 2007; Murphy & Collier, 1999; Wildekamp, 1993) and consists of 16 species currently accepted as valid, which are, with the exception of two species from Gabon, endemic to the Congo drainage.

Only three species are currently known to occur in the eastern part of the Congo Basin: *A. christyi* (Boulenger, 1915), *A. schoutedeni* (Boulenger, 1920), and *A. castaneum* Myers, 1924 (Fig. 1). A fourth species, *A. margaretae* Fowler, 1936, is currently considered as a synonym to *A. christyi* (Van der Zee & Huber, 2006). The majority of museum collections of these species originate from the right bank of the Congo River. *Aphyosemion schoutedeni* was assumed to be restricted to the type locality "Medje at the Naya River", a tributary to the Aruwimi Basin, about 300 km northeast of Kisangani. Although the types are in good condition, all colour has disappeared. Since nothobranchiid species, at least within species groups or genera, differ little in morphological characters (Scheel, 1968, 1990), colour pattern of the male is crucial for species identification. Topotypes collected by Lang and Chapin in 1910, however, still have their colour pattern preserved (Van der Zee & Huber, 2006) and it is close to that of *A. castaneum* with the exception of the anal fin colour pattern. This colour pattern is also present in several *Aphyosemion* collections in the Royal Museum for Central Africa (MRAC) (Tervuren, Belgium) originating from the Aruwimi Basin, east of the Kisangani-Buta road

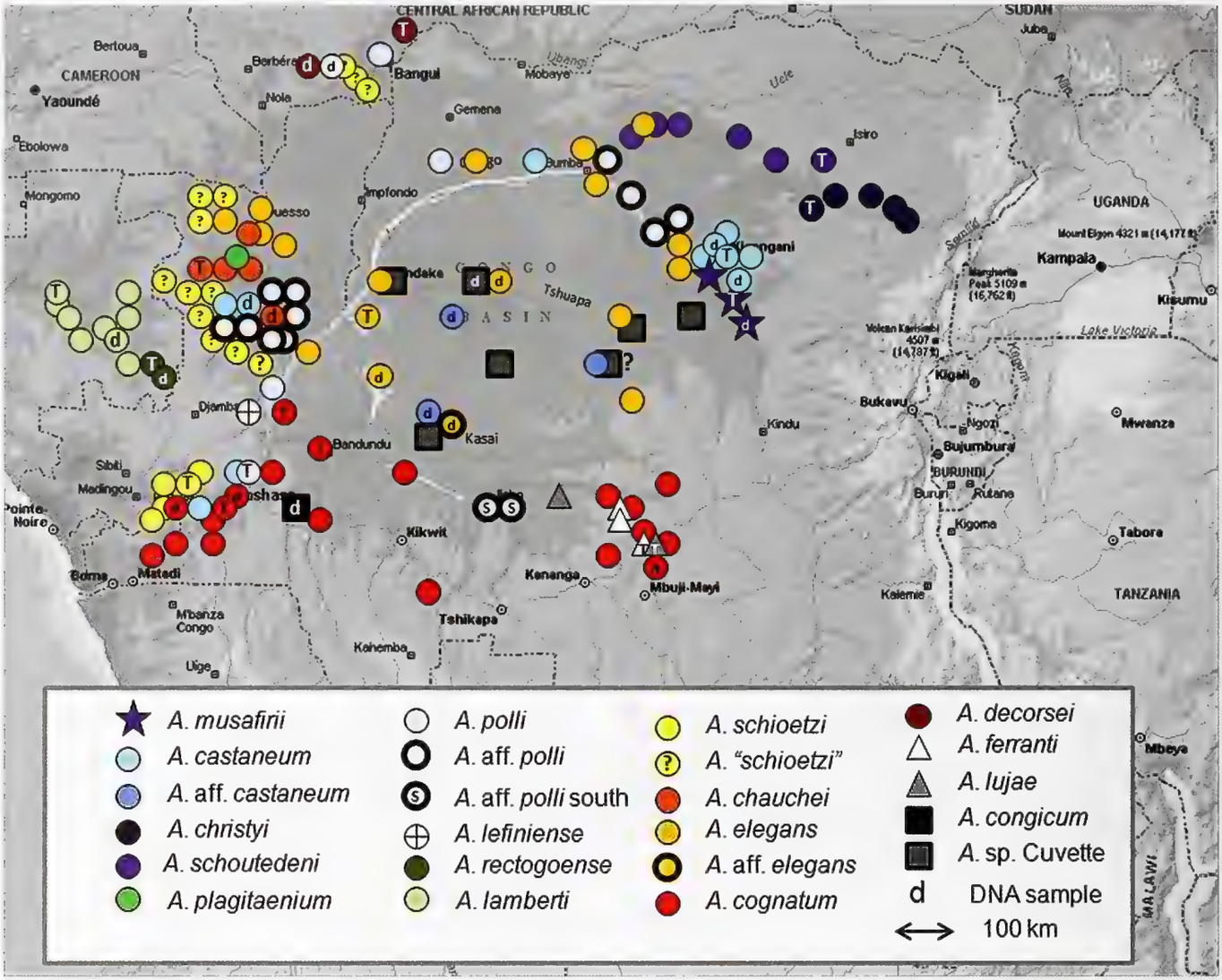

Fig. 1. Map showing the distribution of the genus *Aphyosemion*. Type localities are indicated by a T in the species symbol. The type locality for *A. congicum* is unknown and for *A. lefiniense* and *A. plagitaenium* only collections from the type locality or in proximity are currently known.

and may well represent *A. schoutedeni*. *Aphyosemion christyi* is restricted to the Epulu and Ituri drainages (about 350 km east of Kisangani) and is the only species that can be identified by morphological characters (i.e., higher number of dorsal fin rays than all other species) (Boulenger, 1915; Van der Zee & Sonnenberg, unpubl. data).

Aphyosemion castaneum has long been misidentified as *A. christyi* in literature and only recently Van der Zee & Huber (2006) demonstrated that *A. christyi* is restricted to elevations above 500 m over a distance of 180 km northeast of the type locality, Bafwasende. *Aphyosemion castaneum* is widespread around Kisangani, but additional records of this species are known from Salonga Park by Scheel (1990), who didn't specify the exact location within the park, Lompole, and Yaka in the central Congo Basin (Huber, 2005b). According to Huber (2005b) it is likely that these populations represent a different, undescribed species. Consequently, *A. castaneum* might be restricted to the right bank of the Congo River (Huber, 2005b), with the exception of some populations that were found close to the left bank, and the specimens collected on the left bank with a wide distribution in the central basin were distinguished here as *A.* sp. aff. *castaneum* (Fig. 1).

From the Romée and Ruiki Rivers on the left bank of the Congo River in the eastern part of the central Congo drainage, three collections of *Aphyosemion* are known from the MRAC, originally identified as *A. christyi*. The colour pattern of the anal and caudal fins in preserved specimens differs from *A. castaneum,* which is widespread around Kisangani. In 2007, A. Van Deun (Leuven, Belgium) collected a species of *Aphyosemion* with the same colour pattern as the three previous collections from the Romée and Ruiki Rivers, at two localities just north of

Table 1. List of specimens used for the DNA analyses with locality information and GenBank accession numbers. Abbreviations: DRC = Democratic Republic of Congo; RCA = Republic of Central Africa; US = sample provided by Uli Schliewen, ZSM, Munich; AS = aquarium bred strain; CI = commercial import; WC = wild caught sample.

Species	sample no.	Country	Collection locality	GenBank acc. no.
Aphyosemion castaneum AS	RS1408	DRC	Kisangani	JF307802
A. castaneum AS	RS1499	Republic Congo	Oyo	JF307797
A. castaneum WC	RS1790	DRC	AVD 3	JF307803
A. cf. *chauchei* AS	RS1527	Republic Congo	Olombo	JF307796
A. cf. *decorsei* AS	RS1521	RepublicCongo	Lobaye	JF307795
A. cognatum WC	RS1515	Republic Congo	Mbonza II (US 107)	JF307791
A. cognatum AS	RS1520	DRC	Lake Fwa	JF307793
A. cognatum AS	RS1529	DRC	Kinsuka	JF307794
A. congicum AS	RS1617	DRC	Z 82/17	JF307798
A. elegans WC	RS1747	DRC	Boende CI 2006	JF307792
A. elegans WC	RS1513	DRC	Inongo (US 24)	JF307790
A. elegans WC	RS1514	DRC	Inongo (US 66)	JF307789
A. lamberti AS	RS1256	Gabon	BSWG 97/9	JF307781
A. musafirii WC	RS1787	DRC	AVD 1	JF307804
A. polli AS	RS1584	DRC	CI	JF307800
A. polli AS	RS1479	RCA	RCA 91/1, Kapou 1	JF307801
A. rectogoense AS	RS1419	Gabon	PEG 95/16	JF307799
A. sp. aff. *castaneum* WC	RS1506	DRC	Lompolé (US 74)	JF307782
A. sp. aff. *castaneum* WC	RS1507	DRC	Lompolé (US 79)	JF307783
A. sp. aff. *castaneum* WC	RS1510	DRC	Yaka (US 33)	JF307786
A. sp. aff. *castaneum* WC	RS1511	DRC	Yaka (US 45)	JF307787
A. sp. aff. *castaneum* WC	RS1512	DRC	Yaka (US 61)	JF307788
A. sp. aff. *elegans* WC	RS1508	DRC	Lui Kotalé (US 75)	JF307784
A. sp. aff. *elegans* WC	RS1509	DRC	Lui Kotalé (US 77)	JF307785
A. sp. Cuvette AS	RS1019	DRC	Boende 2002	JF307780
Mesoaphyosemion cameronense	RS262	Cameroon	CMM 40	AY748282

Ubundu on the left bank of the Congo River. Based on live male colour pattern and a preliminary mitochondrial DNA analysis this species is described here as *Aphyosemion musafirii,* new species.

MATERIAL AND METHODS

Morphometric measurements were taken with a digital calliper, partly under a dissecting microscope, and rounded to the nearest 0.1 mm. Counts and methods follow Amiet (1987). Measurements, including subunits of head, are presented as percentages of standard length (SL). The number of all visible rays of dorsal, anal, caudal, pelvic, and pectoral fins were counted, the abbreviation D/A means the relative position of the first dorsal fin ray with regard to the opposite anal fin ray. Count of scales on the mid-longitudinal series is the number of scales between the upper attachment of the opercular membrane and the caudal fin base. Excluded are the scales posterior to the hypural junction, which were counted separately. Nomenclature for the neuromast system on the head follows Scheel (1968) and Van Bergeijk & Alexander (1962), and that for the supraorbital (frontal) squamation follows Hoedeman (1958).

Total DNA was extracted from fin clips or muscle tissue from the caudal peduncle of ethanol preserved specimens, following a modified DNA extraction protocol after Gustinicich et al. (1991). Specimens used for DNA analyses are listed in Table 1 with GenBank accession numbers. A fragment of the mitochondrial cytochrome b gene was sequenced for 25 specimens of *Aphyosemion* and *Mesoaphyosemion cameronense* (GenBank accession number

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Table 2. Uncorrected p-distances for the mitochondrial cytochrome b sequences with pairwise exclusion of missing data. Abbreviations for the DNA samples: CAM = *M. cameronense*, CAS = *A. castaneum*, cCHA = *A.* cf. *chauchei*, COG = *A. cognatum*, CON = *A. congicum*, cDEC = *A.* cf. *decorsei*, ELE = *A. elegans*, LAM = *A. lamberti*, MUS = *A. musafirii*, POL = *A. polli*, REC = *A. rectogoense*, sCAS = *A.* sp. aff. *castaneum*, sELE = *A.* sp. aff. *elegans*, spCU = *A.* sp. Cuvette.

species	CAM 262	spCU 1019	CON 1617	CAS 1499	CAS 1408	CAS 1790	MUS 1787	POL 1479	POL 1584	LAM 1256	REC 1419	sCAS 1506	sCAS 1507	sELE 1513	sELE 1514	sCAS 1510	sCAS 1511	sCAS 1512	ELE 1747	sELE 1508	sELE 1509	cDEC 1521	cCHA 1527	COG 1520	COG 1529
spCU1019	12.6																								
CON1617	14.9	5.9																							
CAS1499	13.0	7.9	6.9																						
CAS1408	13.4	7.0	6.5	2.0																					
CAS1790	13.4	7.1	6.3	2.1	1.7																				
MUS1787	13.7	6.6	5.8	3.4	3.3	3.2																			
POL1479	12.9	7.9	7.2	6.3	5.7	5.5	5.0																		
POL1584	13.0	7.8	7.6	6.1	5.4	5.5	5.0	1.1																	
LAM1256	13.0	7.5	6.7	5.9	5.8	5.7	4.6	5.1	5.1																
REC1419	13.7	8.2	7.1	6.4	6.3	5.9	5.4	5.1	5.1	3.0															
sCAS1506	13.2	8.2	7.8	7.1	7.2	6.8	6.6	7.6	7.6	6.3	6.2														
sCAS1507	13.2	8.6	7.9	7.0	7.2	6.8	6.6	7.6	7.6	6.6	6.2	0.7													
sELE1513	13.2	8.3	7.6	7.1	7.2	6.8	6.6	7.4	7.4	6.3	5.9	0.4	0.3												
sELE1514	13.4	8.4	7.8	7.0	7.1	6.7	6.4	7.5	7.5	6.4	6.1	0.7	0.3	0.3											
sCAS1510	13.3	9.1	8.4	7.4	7.5	7.1	7.1	8.2	8.2	7.1	6.7	1.2	0.8	0.8	0.8										
sCAS1511	13.6	9.1	8.4	7.4	7.5	7.1	7.1	8.2	8.2	7.1	6.7	1.2	0.8	0.8	0.8	0.3									
sCAS1512	13.3	9.1	8.4	7.4	7.5	7.1	7.1	8.2	8.2	7.1	6.7	1.2	0.8	0.8	0.8	0.0	0.3								
ELE1747	13.3	8.8	8.0	7.1	7.2	7.1	6.8	7.5	7.5	6.6	6.4	0.8	0.7	0.4	0.7	0.9	0.9	0.9							
sELE1508	13.6	8.7	8.3	7.0	7.1	6.7	7.0	7.5	7.8	7.0	6.6	1.6	1.4	1.2	1.4	1.7	1.7	1.7	1.3						
sELE1509	13.3	8.7	8.3	7.2	7.4	7.0	7.0	7.5	7.8	7.0	6.6	1.6	1.4	1.2	1.4	1.7	1.7	1.7	1.3	0.3					
cDEC1521	13.5	8.3	8.0	7.9	8.0	7.6	7.4	8.0	8.0	7.1	6.7	2.0	1.9	1.6	1.9	1.9	1.9	1.9	1.7	2.3	2.3				
cCHA1527	13.3	8.9	8.4	7.6	7.8	7.4	7.1	7.6	7.6	6.8	6.2	1.8	1.7	1.4	1.7	2.0	2.0	2.0	1.6	2.4	2.1	1.5			
COG1520	13.4	8.4	8.2	7.5	7.6	7.5	6.8	7.9	7.9	6.6	6.4	3.8	3.7	3.4	3.6	3.9	3.9	3.9	3.3	4.1	4.1	3.9	3.6		
COG1529	13.4	8.4	8.2	7.5	7.6	7.5	6.8	7.9	7.9	6.6	6.4	3.8	3.7	3.4	3.6	3.9	3.9	3.9	3.3	4.1	4.1	3.9	3.6	0.0	
COG1515	12.8	7.9	7.2	6.7	6.8	6.4	6.2	7.0	7.0	6.3	5.8	2.9	2.8	2.5	2.6	3.0	3.0	3.0	2.7	3.2	3.2	2.7	2.5	3.0	3.0

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Fig. 2. *Aphyosemion musafirii*, male, collected with the types by A. Van Deun, 22.10. 2007, not preserved. Type locality, 67 km on the road from Kisangani to Ubundu, Democratic Republic of Congo. Photo: H. Ott.

AY748282, published in Sonnenberg & Blum [2005]) was used as outgroup, for lab protocols see Sonnenberg et al. (2006).

Resulting sequences were aligned with ClustalX 1.8 (Thompson et al., 1997) and checked by eye in BioEdit 7.0.5.3 (Hall, 1999). All sequences were translated into the corresponding amino acids and tested for the anti-G bias of mitochondrial sequences (Zhang & Hewitt, 1996) to confirm for functionality and mitochondrial origin. Uncorrected p-distances with pairwise exclusion of missing data were calculated in MEGA 4.1 beta 3 (Tamura et al., 2007) and are given in Table 2.

Fig. 3. *Aphyosemion musafirii*, male, 7 km north of Ubundu, Democratic Republic of Congo, collected by A. Van Deun, 22.10.2007, not preserved. Photo: H. Ott.

Analyses of sequence data were performed with PAUP 4.0b10 (Swofford, 1998) by maximum parsimony and with MrBayes 3.1.2 (Huelsenbeck & Ronquist, 2001) by a Bayesian approach, all analyses with the identical respective settings given in Sonnenberg & Busch (2010). In addition, we performed a maximum parsimony analysis with the same parameters as the previous, but with exclusion of the third protein coding position. Only nodes, which are supported with bootstrap values above 75% or posterior probabilities above 95% were considered as supported by the data.

We used the software SplitsTree (Huson & Bryant, 2006) to calculate a split decomposition network representation of the dataset.

As species concept we adopted the approach by Moritz et al. (2000), which is similar to the Evolutionary or Phylogenetic species concepts (as discussed in Kottelat, 1997).

RESULTS

Aphyosemion musafirii, new species

(Figs 2–6, Tables 3–5)

Holotype. MRAC 2011-007-P-1, male, 36.7 mm SL, Democratic Republic of Congo, Tshopo Province, 67 km on the road from Kisangani to Ubundu (1°30' N, 25°21' E), 450 m altitude, north-eastern Congo basin, A. Van Deun, 22 October 2007.

Fig. 4. *Aphyosemion musafirii*, male, F1 from specimens collected 7 km north of Ubundu, Democratic Republic of Congo, showing a different anal fin pattern than most of the wild collected males from that population. Photo: W. Grell.

Paratypes. MRAC 2011-007-P-2-5, 4 females, 30.1–33.5 mm SL, collected with the holotype; MRAC 2011-007-P-6-9, 4 males, 32.9–34.6 mm SL, collected with the holotype.

Additional non-type material. MRAC 90-30-P-1471, labelled as *A. christyi* (Boulenger, 1915), Democratic Republic of Congo, Ubundu, L. De Vos, February 1990.

MRAC 90-47-P-846-853, labelled as *A. christyi* (Boulenger, 1915), Democratic Republic of Congo, Riv. Romée, km 30 route Kisangani-Opala, L. De Vos & C. Danadu, 07.02.1990.

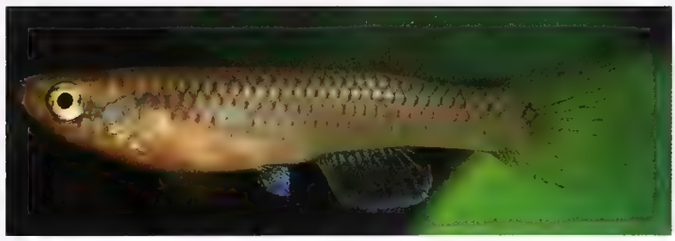

Fig. 5. *Aphyosemion musafirii*, female, 7 km north of Ubundu, Democratic Republic of Congo, collected by A. Van Deun, 22.10.2007, not preserved. Photo: H. Ott.

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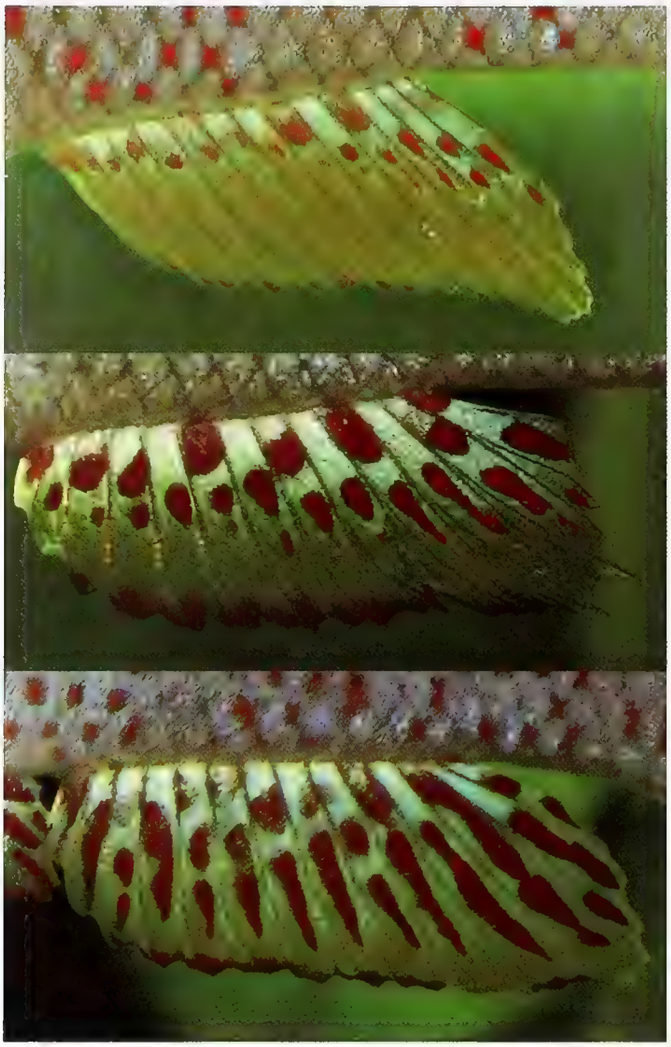

Fig. 6. Variability of the anal fin pattern in *Aphyosemion musafirii* (all examples from wild caught specimens).

MRAC 90-47-P-854-863, labelled as *A. christyi* (Boulenger, 1915), Democratic Republic of Congo, Riv. Romée km 3, rive gauche, route Kisangani-Opala, L. De Vos & C. Danadu, 10.–17.04.1990.

Diagnosis. *Aphyosemion musafirii* (Fig. 2–6) is placed within the genus *Aphyosemion* by the combination of the following characters: preopercular neuromast system with 6 pores, slender body, posterior origin of dorsal fin with less than 10 fin rays, females with a strong reticulation due to dark scale borders, and the extended edges of the caudal fin in males (Huber, 2005a).

Males of *A. musafirii* differ from all other representatives of *Aphyosemion* in the north-eastern Congo Basin by the in average broader red margin of the dorsal fin. This red border is narrow (up to 10%) in all other species in this area and is often absent at the distal end of the fin.

Males of *A. musafirii* differ from *A. castaneum* by the absence of a red band in the approximate centre of the anal fin, absence of a red infra-buccal band, absence of red edges around the light ventral zone in the caudal fin, absence of, or only very narrow, yellow margin of pelvic fins and a higher average number of red dots on side (*A. musafirii*: min. 51, max. 117, average = 79, sd = 23, number of specimens = 11; *A. castaneum*: min: 13, max. 57, average = 30, sd = 15, number of specimens = 20). These dots are arranged in more or less regular, interrupted rows in *A. musafirii*, whereas these dots are irregularly distributed in *A. castaneum*. The higher number of red dots on the side also distinguishes males of *A. congicum* (25–40), *A. schoutedeni* (17–28) and *A. polli* (11–49) from *A. musafirii*. It can also be distinguished by the more or less regular interrupted rows of red dots from *A.* sp. Cuvette, *A. elegans* (Boulenger 1899), and *A. plagitaenium*, which have either a pattern of vertical streaks or oblique bars on the side in males. Males of *A. musafirii* differ from *A. schoutedeni* by the same characters as *A. castaneum*, with the exception that *A. schoutedeni* lacks a red band in the anal fin. Males of *A. musafirii* have less spots in the caudal fin than *A. christyi* (35–55 in *A. musafirii*; over 70 in *A. christyi*). The background colour of the flanks is blue-green in *A. musafirii* and purple-blue in *A. christyi*. In addition to colouration characters, males of *A. musafirii* can be distinguished from *A. christyi* by the lower number of dorsal fin rays (7–9 in *A. musafirii* versus 10–11 in *A. christyi).*

Description. See Figures 2–6 for general appearance and Tables 3–5 for morphometric and meristic data of the type series. *Aphyosemion musafirii* shows strong sexual dimorphism, males more colourful, unpaired fins larger, dorsal and anal fins with posterior fin rays extended. A medium sized, slightly laterally compressed species; dorsal profile slightly convex, greatest body depth approximately at pelvic fins. Ventral profile slightly convex from head to end of anal fin, concave on caudal peduncle. Snout slightly rounded, mouth directed upwards, lower jaw longer than upper jaw. Dentary bears an outer row of large and inner irregular rows of smaller unicuspid, curved teeth; the premaxilla bears some larger and several smaller unicuspid and curved teeth.

Frontal (after Scheel, 1968) or nasal (after van Bergeijk & Alexander, 1962) neuromasts in separate grooves, the preopercular canal with six pores.

Scales cycloid, entirely scaled except ventral surface of head; frontal squamation of G-type; scales on mid-longitudinal series 29–30, with 1–2 scales posterior to the hypural plate; 7 transversal scales, 12 scales around the caudal peduncle.

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Table 3. Morphometrics of *Aphyosemion musafirii*, new species, (H = holotype, P = paratypes: 4 males and 4 females). All measurements in percentages of standard length, standard length in mm.

	H ♂	P ♂	P ♂	P ♂	P ♂	P ♀	P♀	P ♀	P ♀
Standard length	36.7	34.6	34.2	33.3	32.9	33.5	32.6	31.3	30.1
Body depth	21.0	18.4	19.6	19.5	18.8	18.8	20.8	20.1	21.4
Head length	21.5	20.5	21.6	21.0	20.4	19.1	20.5	19.5	19.0
Eye diameter	6.3	6.3	6.4	6.3	6.1	5.7	6.4	6.4	6.9
Interorbital width	12.0	12.7	11.1	11.4	12.5	10.7	11.3	11.2	13.0
Pre-dorsal length	63.2	61.0	66.0	66.4	62.1	60.2	66.2	65.8	63.5
Pre-anal length	55.0	54.9	53.5	54.3	50.8	55.2	56.1	54.6	57.3
Dorsal fin base	11.2	12.1	10.2	11.1	11.2	11.0	10.1	10.9	11.0
Anal fin base	19.1	18.8	17.5	19.2	18.2	17.3	16.1	17.3	17.2
Caudal peduncle depth	12.5	11.5	11.1	11.7	11.6	10.7	11.7	11.5	11.9

Small dorsal fin with 7–9 fin rays, first dorsal fin ray inserts above the 7–10th anal fin ray; anal fin with 13–15 rays; posterior dorsal and anal fin rays slightly elongated in males; caudal fin with 21–24 rays, with extensions on upper and lower fin rays. Pectoral fin with 12–14, pelvic fin with 5 rays.

Live colouration Males. (Figs 2–4 & 6) Flanks greyish brown with blue-green iridescence. Edges of scales on the flanks with dark pigmentation resulting in a reticulated pattern. Dorsally the scales have broader pigmented edges than ventrally. Flanks with approximately 50 to 120 red spots. These spots are mainly situated at the anterior edge of the scales and are mostly irregularly distributed in lines, usually forming up to five parallel lines. Three red streaks on opercle in an approximate 45° angle. Infra-buccal band absent or only present at the sides of the jaw.

Table 4. Meristics of *Aphyosemion musafirii*, new species. Numbers indicate observed values; numbers in parentheses frequency of occurrence; values found for the holotype are indicated by an asterisk.

meristic count	values (frequency)
dorsal fin rays	9 (3*), 8 (4) 7 (2)
anal fin rays	13 (5*), 14 (3), 15(1)
D/A	+7 (1*), +8 (1), +9 (3), +10 (4 fem.)
caudal fin rays	21 (3*), 22 (2), 23 (3), 24 (1)
pelvic fin rays	5 (9*)
pectoral fin rays	12 (2*), 13 (6), 14 (1)
lateral line scales	29 (2), 30 (6*), 31 (1)
transversal row scales	7 (9*)
circumpenduncul. scales	12 (9*)

Pectoral fin yellow, unspotted or just with some tiny spots in the centre. Pelvic fin yellow with several prominent red spots. Dorsal and anal fin blue iridescent at the base and yellow distally, provided with red spots; spots more numerous and larger at the base than distally. Dorsal fin edged with a broad dark red band (up to 30% of fin length at mid section). Anal fin edged with a narrow red band. Spots on anal fin rounded to elongated, sometimes missing at the distal part of the fin, leaving a broad yellow subdistal band. Caudal fin light blue with yellowish distal edges provided with rounded and/or 35–55 elongated red spots. Dorsal and ventral edge of the caudal fin provided with a broad dark red band.

Females. (Fig. 5) Flanks grey with darker reticulation. Red streaks on opercle reduced and infra-buccal band absent. All fins transparent. Edge of anal fin and distal part of ventral fins light blue. Faint spots on anal fin, more prominent spots on base of dorsal and dorsal part of caudal fin.

After one year of preservation in ethanol. Males. Flanks light brown with transition to light ventral side. Reticulation, buccal band, and red streaks on opercle as in live specimens. Spots on flanks as in live specimens, but smaller and more vague. All fins transparent greyish, provided with spots as in live specimens, but vague and pink.

Females. As in live specimens, but spots on anal fin hardly visible.

Distribution. (Fig. 1) *Aphyosemion musafirii* is restricted to brooks in the Ruiki and Romée River systems on the left bank of the Congo River between Kisangani and Ubundu, Tshopo Province, Democratic Republic of Congo.

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Table 5. Comparison of the morphometric values for *Aphyosemion musafirii*, new species, and members of the subgenus *Aphyosemion*. Abbreviations used in the table: CAS = *A. castaneum*, CHR = *A. christyi*, COG = *A. cognatum*, CON = *A. congicum*, LEF = *A. lefiniense*, MEL = *A. melanopteron*, MUS = *A. musafirii*, POL = *A. polli*, TEU = *A. teugelsi*, E = eye diameter, I = interorbital width, BD = body depth, HL = head length, HW = head width, pD = predorsal fin distance, pA = preanal fin distance, DB = dorsal fin base, AB = anal fin base, CD = caudal peduncle depth, sd = standard deviation.

species	location	sex	SL	E	I	BD	HL	pD	pA	DB	AB	CD
COG	Z 91/3,	♂	33.5	8.0	11.0	22.9	18.9	67.1	62.2	11.5	21.9	14.3
CHR	HZ 85/14,	♂	29.1	7.9	9.3	18.4	21.9	65.7	59.0	11.6	19.6	11.2
	Epulu	♀	31.2	7.8	9.3	17.1	22.1	64.5	58.7	11.3	19.9	10.9
POL	RCA 91/1,	♂	36.0	7.5	10.6	22.5	23.3	68.3	59.4	12.1	21.7	13.1
	Kapou	♀	29.1	6.9	8.2	23.6	22.7	67.0	61.9	11.7	19.9	12.6
CON	type of MEL	♂		7.8	9.5	21.6	27.8	67.3	61.5	12.1	20.9	13.4
CAS	HZ 85/13	♂	20.8	7.7	13.4	20.4	20.2	70.2	53.8	12.0	22.1	11.1
		♀	19.4	7.7	11.9	20.8	19.8	68.3	52.1	11.5	20.0	12.3
LEF	Luna River	♂	23.1	8.7	12.1	19.0	24.1	66.6	54.9	7.0	13.0	9.6
		♀	19.2	8.3	11.4	21.0	23.6	69.9	57.0	8.6	16.2	11.8
mean				7.8	10.6	20.8	22.2	67.7	58.1	11.0	19.6	12.2
sd				0.5	1.4	2.0	2.6	1.9	3.4	1.6	2.7	1.4
range				6.9–8.7	8.2–13.4	17.1–23.6	18.9–27.8	64.5–70.2	52.1–62.2	8.6–12.1	13.0–22.1	9.6–14.3
MUS												
mean				6.3	12.1	19.2	30.9	68.3	61.1	14.6	19.0	12.4
sd				0.3	0.5	2.2	1.0	1.6	1.5	0.7	1.2	0.2
range				5.4–16.9	11.3–12.8	16.6–21.2	29.3–32.0	66.0–70.5	59.2–62.8	13.8–15.3	17.4–20.7	12.1–12.7

Etymology. *Aphyosemion musafirii* is named after Dr. Jean Musafiri (Ubundu, Democratic Republic of Congo), coordinator for the national tuberculosis and leprosy control programme in the "Province Orientale Occidentale", the huge forest area around Kisangani. The name Musafiri means "traveller" in Swahili. Indeed, he travels around the area under very difficult circumstances, covering enormous distances by jeep, motorised canoe or small motorcycle. Dr. Musafiri was born in Ubundu and has always stayed in the province to help his people, in spite of the very difficult living conditions and the atrocities of the war in the eastern Democratic Republic of Congo. He made it possible that the type material of *A. musafirii* and a new species of *Fenerbahce* (Sonnenberg, Woeltjes & Van der Zee, submitted) could be collected by A. Van Deun (Institute of Tropical Medicine, Antwerp) at the occasion of an external evaluation visit of the tuberculosis/leprosy programme.

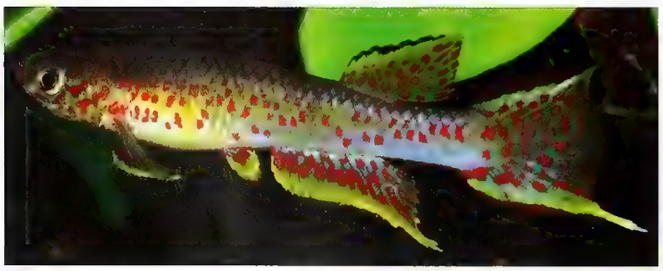

Fig. 7. *Aphyosemion castaneum*, 11 km west of Kisangani, Democratic Republic of Congo, not preserved. Photo: H. Ott.

Fig. 8. *Aphyosemion castaneum*, Wani Rukula, 65 km southeast of Kisangani, Democratic Republic of Congo. Photo: H. Ott.

DNA analyses. The resulting sequence alignment has a final length of 760 bp, the base composition shows the, for mitochondrial sequences typical, A/T bias (Zhang & Hewitt, 1996). In two sequences (RS1747 and RS1521), up to 13 N were introduced at the start of the alignment for equal sequence length. We found 192 variable and 130 phylogenetic informative positions. The DNA fragment translates into 253 amino acids, of which 27 are variable and 15 phylogenetic informative, and contains no unexpected stop codon. Uncorrected pairwise distances be-

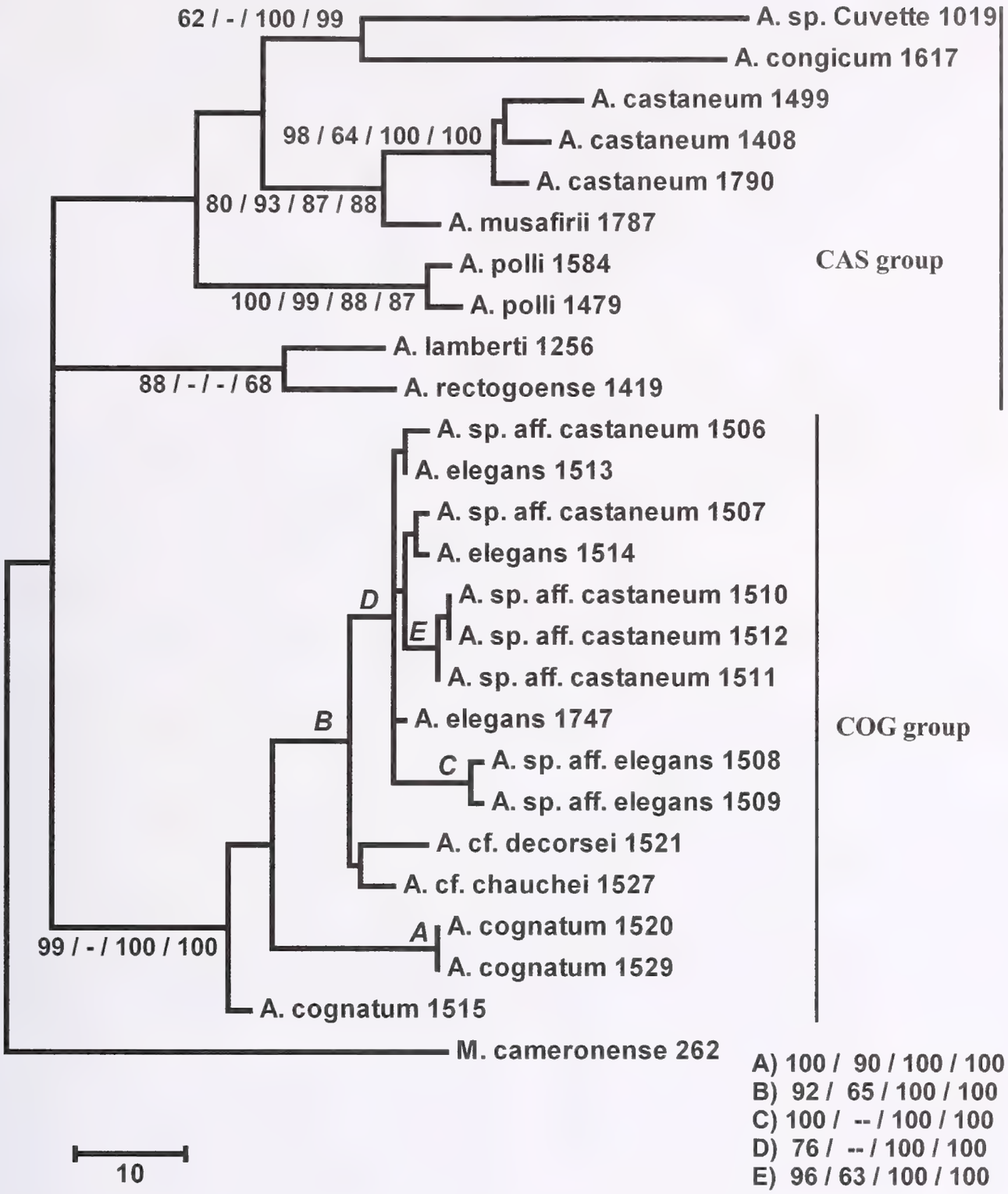
62 / - / 100 / 99
A. sp. Cuvette 1019
A. congicum 1617
A. castaneum 1499
98 / 64 / 100 / 100
A. castaneum 1408
A. castaneum 1790
80 / 93 / 87 / 88
A. musafirii 1787
A. polli 1584
CAS group
100 / 99 / 88 / 87
A. polli 1479
A. lamberti 1256
88 / - / - / 68
A. rectogoense 1419
A. sp. aff. castaneum 1506
A. elegans 1513
A. sp. aff. castaneum 1507
A. elegans 1514
D
A. sp. aff. castaneum 1510
E
A. sp. aff. castaneum 1512
A. sp. aff. castaneum 1511
B
A. elegans 1747
COG group
C
A. sp. aff. elegans 1508
A. sp. aff. elegans 1509
A. cf. decorsei 1521
A. cf. chauchei 1527
A
A. cognatum 1520
99 / - / 100 / 100
A. cognatum 1529
A. cognatum 1515
M. cameronense 262
A) 100 / 90 / 100 / 100
B) 92 / 65 / 100 / 100
C) 100 / -- / 100 / 100
D) 76 / -- / 100 / 100
E) 96 / 63 / 100 / 100
10

Fig. 9. Phylogenetic tree by maximum parsimony, tree length = 283, consistency index = 0.5194, homoplasy index = 0.4806, retention index = 0.7467, and rescaled consistency index = 0.3879. Shown is one of 36 equally short trees, on the left side of nodes support values are shown for maximum parsimony bootstrap analyses and Bayesian posterior probabilities in the following order: maximum parsimony / maximum parsimony with exclusion of third position / Bayes with Nst = 2 / Bayes with Nst = 6. Only support values for nodes are shown, for which at least in one analysis a bootstrap value of 75% or posterior probabilities of 95% were reached. No value given means that the support value in all analyses is below the previous given values or the node is not recovered in the analysis. Some values are given below the tree and are indicated on the respective nodes by a capital letter for better readability.

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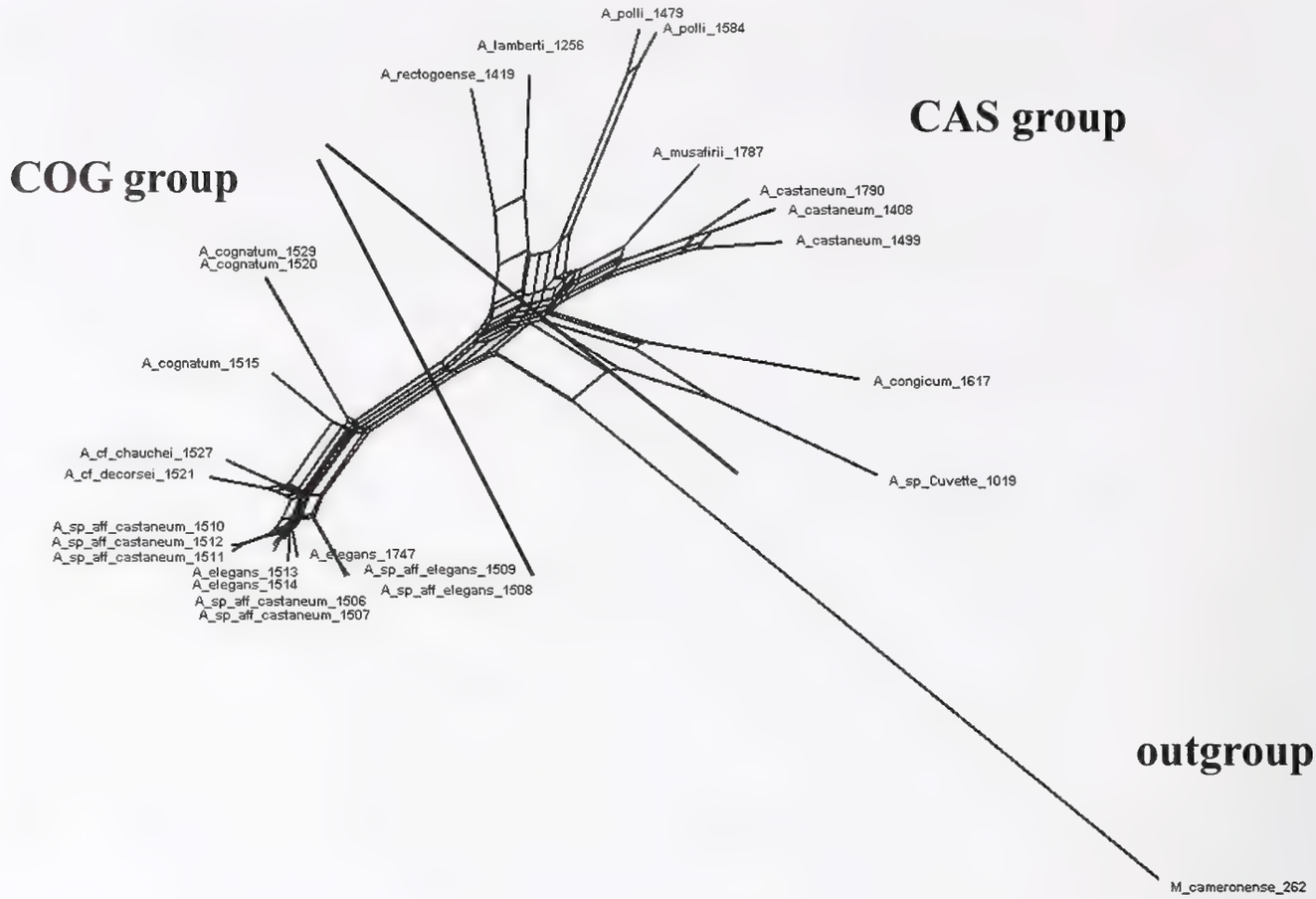

Fig. 10. SplitsTree network representation of the *Aphyosemion* dataset. Number of taxa = 26, 760 base pairs, fit = 98.01, uncorrected p-distances, neighborNet.

tween sequences are presented in Table 2, the observed values found between *Aphyosemion* and *Mesoaphyosemion* as the outgroup range from 12.6–14.9%, the maximum observed value within *Aphyosemion* is 9.1%.

The samples of *A. cognatum* from aquarium strains originating from Kinsuka and Lake Fwa are, despite nearly 900 km distance, identical, and also with the shorter sequence of an *A. cognatum* from Lake Fwa published by Murphy & Collier (1999, GenBank acc. no. AF002324), therefore it might be possible that the strains were erroneously mixed or mislabelled since their introduction in the killifish hobby. A test with a second specimen from the Kinsuka strain resulted in the same sequence (data not shown).

The *A. cognatum* 1515 sample is only represented by a female, so the species identification is tentative based on the knowledge of other *Aphyosemion* collections around this area and the resulting sequence is identical with a shorter sequence of Murphy & Collier (1999, GenBank acc. no. AF002327), which they have published as *A. elegans* from Naoimda, and slightly different from their sequence of what they call *A. elegans* from Madimba (GenBank acc. no. AF002328). It is not clear if Naoimda is a misspelling of Madimba. However, the specimens from Madimba belong to *A. cognatum* (e.g. see Seegers, 1997, p. 74), the sequences differ in only two bases.

The phylogenetic analyses (Fig. 9) give an only partially resolved tree of the analysed specimens. In addition, there are differences in support for nodes; excluding the third protein coding positions gives no bootstrap support above 50% for several nodes, which were recovered by the other analyses (Fig. 9). *Aphyosemion musafirii* seems to be closer to *A. castaneum,* however, this node is only supported by the maximum parsimony analyses. Comparing the phylogenetic hypotheses summarized in the tree (Fig. 9) with the split-decomposition network representation (Fig. 10), the network indicates a clear separation of the analysed specimens into two main groups, which is not that prominent in the dichotomous phylogenetic hypotheses (Fig. 9). One group, in the following called the *A. castaneum* group (CAS) is characterised by longer branches between the species (range 1.1–8.2% p-distance), whereas the second group, the *A. cognatum* group (COG) has

shorter internal branch length (0.0–4.1% p-distance), the divergence between both groups ranges between 5.8–9.1% p-distance. The CAS group contains, according to the network (Fig. 10), five species, which were found from the western to the eastern Congo Basin, and two species from Gabon. However, this group is not recovered by the phylogenetic analyses with any significant support (Fig. 9). The second group in the network (Fig. 10) is recovered with high support (Fig. 9) at least by three analyses and contains samples from the western and central Congo Basin.

DISCUSSION

Colour pattern

The main criterion for distinguishing species in nothobranchiids and especially *Aphyosemion* is the male colour pattern. All Nothobranchiidae show a polygamous mating system and a high degree of sexual dimorphism. Amiet (1987) therefore assumed that male colouration might be important in mate choice of females in nothobranchiid fishes. Van der Zee et al. (2007) assumed that especially the colour pattern of the caudal peduncle and unpaired fins plays an important role in female mating preferences. Kullmann & Klemme (2007) were able to demonstrate for *Chromaphyosemion* that females prefer to mate with their own males, for *Diapteron* this was studied by Brosset & Lachaise (1995). Thus female mate choice on divergent male colour characters may enable speciation by sexual selection. After secondary contact of previously allopatric populations, species cohesion is then easily maintained in parapatry or sympatry.

The current study shows that the genus *Aphyosemion* remains taxonomically problematic, which is in part due to old type material with no traces of the most important characters, the male colouration pattern, and descriptions, which do not give detailed information about live or preserved colouration. On the other hand, many species show a certain degree of variation in colour pattern within and between populations, which makes identification in some cases difficult. Differing species identification between authors further complicates killifish literature, as for example in the case of the *A. elegans* samples in the study of Murphy & Collier (1999) mentioned above. A third sample listed as *A. elegans* in their study, an aquarium strain from Epoma (Murphy & Collier, 1999) was later described as *A. plagitaenium* by Huber (2004).

Phylogeny

Our preliminary molecular phylogeny of this group gives a very complex pattern. The CAS (*A. castaneum*) group might be not a monophyletic unit, but consists of several species with deep divergences, which is reflected by the large p-distances found in this group (Table 2). The root of the group might be placed close to this species complex (Fig. 10). The COG (*A. cognatum*) group consists of species with lower within-group p-distances (Table 2), appears to be monophyletic and might contain species of more recent origin. Both groups cover large ranges in the Congo and adjacent river basins in Gabon (*A. lamberti* and *A. rectogoense*), have a kind of mixed distribution and occur in some cases in sympatry (e.g. *A. elegans* and *A.* sp. Cuvette) or even syntopically (*A.* sp. Cuvette and *A.* sp. aff. *castaneum; A. chauchei* and *A. elegans*; *A. "schioetzi"* and *A. polli*).

Interestingly some phenotypically different species (*A.* sp. aff. *castaneum* and *A. elegans* / *A.* sp. aff. *elegans*) in the Cuvette centrale turn out to be closely related and not genetically separated by the mitochondrial DNA data (Fig. 9). Compared with some additional nuclear 28S rDNA (LSU) sequences (unpublished data), it turns out that the studied samples can be separated into two groups: one including *A. castaneum* and *A.* sp. aff. *castaneum* and on the other hand the samples of *A. elegans* / *A.* sp. aff. *elegans*. This indicates that most probably mitochondrial introgression between species of the CAS and COG group has occurred in an area were both groups are at least parapatric. However, despite the potential of hybridization as is indicated by the mitochondrial introgression, both species or species groups live at least in sympatry and have stable distinguishing characters.

Distribution of the genus *Aphyosemion*

With the addition of *A. musafirii* the number of species in the eastern Congo Basin is increased to four (see Introduction). The study of the *Aphyosemion* specimens in the MRAC by the first author also added some collections of other species from this area (Fig. 1), in part due to misidentified samples. However, the maximum number of eight species is found in the westernmost part of the Congo Basin. An artificial factor, which might explain the concentration of species here, is the higher number of samples from this area. A natural cause of high species diversity might be the proposed existence of a forest refuge during dryer periods in the past (Leal, 2004; Maley, 1996; Plana, 2004). Two of these eight species are widely distributed in the northern part of the basin: *A. castaneum* Myers, 1924 and *A. polli* Radda & Pürzl, 1987. These two species were probably transported downstream by the Congo and Ubangui rivers, and both can also be found at Pool Malebo. *Aphyosemion elegans* is here present in the northern tributaries of the Likouala River, but is widespread in the central Congo Basin (Cuvette centrale) and north of the middle Congo section up to Buta.

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Three species have a more restricted distribution in the Central Republic of Congo: *A. chauchei* Huber & Scheel, 1981 is found in the Likouala and Alima drainages, *A. lefiniense* Woeltjes, 1984 is restricted to the southern tributaries of the Lefini River, and *A. plagitaenium* Huber, 2004 is only known from the type locality at Epoma in the northern Central Republic of Congo.

Aphyosemion schioetzi Huber & Scheel, 1981 has a disjunctive distribution: a rather restricted area in the south around the type locality and a huge area in the north, separated by a gap of almost 280 km where only *A. lefiniense* is found (Huber & Scheel, 1981). The present authors suggest that the northern populations (labelled here in the following "*schioetzi*", Fig. 1) do not belong to *A. schioetzi sensu strictu*, since all representatives are lacking the dark red edge of the anal fin and seem to be built more slender than *A. schioetzi*. The northern populations might represent a new species or be conspecific with *A. decorsei* (Pellegrin, 1904). The status of *A. decorsei* has been subject to discussion for a long time (Huber, 1994, 2004, 2005a; Scheel, 1968, 1990; Wildekamp, 1993). Poll (1951) even placed it in *Epiplatys* and in the description of *Haplochilus decorsei* Pellegrin assumed it to be close to *Aplocheilichthys spilauchen*. Myers (1924) placed it in *Aphyosemion* with some hesitation. Scheel (1968, 1990), Huber (1994, 2004, 2005a), and Wildekamp (1993) all have seen the types and they confirmed Myers's statement. The types from the Central African Republic are in poor condition with the colour pattern lost. Huber (2004, 2005a) stated that *A. decorsei* has only few red spots on the flanks and might be conspecific with *A. polli*, the latter being a junior synonym. Wildekamp (1993), however, is convinced that *A. decorsei* has many spots on the flanks, based on the light spots on the scales of the syntypes. Red pigmentation pattern, after preservation in formalin and transfer in ethanol, leaves corresponding patterns of lighter areas than the body colouration (Van der Zee & Sonnenberg, 2010). *Aphyosemion polli* has not only few spots on the flanks, but also has very few spots (or no spots) on the anal fin, arranged near the base of this fin. In the original description of *A. decorsei* Pellegrin writes: "la dorsale, l'anale et des ventrales avec des petits points carmins plus ou moins nombreux" (dorsal, anal, and ventral fins with small more or less numerous carmine spots). The present authors agree with Wildekamp's argumentation: *A. decorsei* is a species with many spots at least on the anal fin.

Aphyosemion cognatum Meinken, 1951 has a huge distribution area in the south from the right bank of the Congo River to Lodja in the upper Lukenie basin. Sympatric with *A. cognatum* occur *A. ferranti* (Boulenger, 1910), *A. congicum* (Ahl, 1924), and *A. lujae* (Boulenger, 1911).

In the large Cuvette centrale only three species occur: a blue species that resembles *A. castaneum* (as *A.* sp. aff. *castaneum* in Fig. 1), *A. elegans,* and another undescribed species (*A.* sp. Cuvette) that can occur sympatrically with *A. elegans*. This species, with a characteristic dark dorsal fin, has long been taken for *A. elegans* in many publications (Radda & Pürzl, 1987; Huber, 2004, 2005a,b; Wildekamp, 1993). However, the description and original drawing do not mention this dark dorsal fin that is very prominent even in preserved specimens (Boulenger, 1899). Our DNA analysis shows that *A. elegans* and *A.* sp. Cuvette are not closely related (Fig. 9). Additionally, the specimens from Lui Kotale (Fig. 1) differ by male colour pattern and are tentatively named *A.* sp. aff. *elegans* to indicate the differences and their potential status as separate species.

Historical influcences on current pattern

The distribution pattern within the group is very complex. Several species are found over large areas (Fig. 1), often mixed with congeners. This complexity is probably related to the history of the Congo Basin.

From our data it cannot be determined when *Aphyosemion* reached the Congo Basin. The ancestors of the extant species must have come from the west where their closest relatives live. With the current data it is not possible to decide if they were already dispersed around the endorheic lake or if they entered the basin after a river capture to the west. Both scenarios will result in different distribution and dispersal patterns.

In later stages forest refuges probably played an important role in the establishment of the mosaic distribution pattern of *Aphyosemion* during glacial dry periods. Almost all species of *Aphyosemion* s.l. are strictly bound to forest cover (Brosset, 1982; Kamdem Toham & Teugels, 1997, 1998, 1999). During glacial periods, the majority of the forest in the Congo Basin was replaced by savannah (see Leal, 2004; Maley, 1996). Only in the western part of the basin a relatively large refuge was present from where dispersal might have originated during more humid periods. Leal (2004) proposed that besides larger well known refuges also micro refuges must have existed, e.g. in Gabon. A combination of one or more larger and several micro refuges from where repeatedly dispersal could have occurred might explain the very complex distribution pattern of *Aphyosemion* in the Congo Basin.

Prospect

Further DNA studies can contribute to alpha taxonomy and towards a better understanding of the phylogeny and bio-

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geography of this group and add to our understanding of its evolution. However, much more samples from the huge distribution area of *Aphyosemion* will be needed and the occurrence of mitochondrial introgression makes it necessary to include several nuclear markers into such a study to get reliable and well supported results.

COMPARATIVE MATERIAL

Part of the comparative material is listed in Van der Zee & Sonnenberg (2010); additional material is listed here and in the Online Appendix:

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Aphyosemion sp.: MRAC 90-30-P-1471, labelled as *A. christyi* (Boulenger, 1915), Democratic Republic of Congo, Yangambi, J. Lambert, 08.05.1957; MRAC 119855-856, labelled as *A. christyi* (Boulenger, 1915), Democratic Republic of Congo, Yangambi, J. Lambert, 09.05.1957.

Aphyosemion castaneum Myers, 1924: MRAC 22555-22561, Democratic Republic of Congo, Stanleyville, Dr. Richard, 1930; MRAC 89-043-P-547-612, labelled as *A. christyi* (Boulenger, 1915), Democratic Republic of Congo, Libuku River near Kisangani, L. De Vos & M. Katembo, April 1988.

Aphyosemion schoutedeni (Boulenger, 1920): MRAC15664-15665, identified by David (1936) as *Epiplatys boulengeri,* Democratic Republic of Congo, Medje, Lang & Chapin, 1910; MRAC 25529, Democratic Republic of Congo, Medje, H. Schouteden, no year.

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The Online Appendix is available at http://www.zfmk.de/web/Forschung/Buecher/Beitraege/index.en.html

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Nothobranchius seegersi (Cyprinodontiformes: Nothobranchiidae), a new annual killifish from the Malagarasi River drainage, Tanzania

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Abstract. A new annual killifish species, *Nothobranchius seegersi*, is described based on specimens collected in ephemeral water bodies in the Wulua River drainage system, Malagarasi River basin, central Tanzania. The new species belongs to the *N. neumanni* species group and is distinguished from *N. neumanni* by different male colouration and longer predorsal length in males and females.

Key words. *Nothobranchius neumanni*, new species, taxonomy, seasonal pool, Tanzania.

INTRODUCTION

The killifish genus *Nothobranchius* occurs in the subtropical and tropical parts of eastern Africa, from Sudan to South Africa, and from Chad to Zanzibar and Mafia islands in Tanzania. All known species are annual fishes, living in temporary pools and swamps formed during the rainy season (Wildekamp 2004). Six *Nothobranchius* species are currently known from central Tanzania: *N. neumanni* from the Great Ruaha, Bubu, Wembere, and Malagarasi River basins, and Lakes Manyara and Victoria drainage systems; *N. robustus* from the Lake Victoria drainage system; *N. taeniopygus* from the Wembere, Malagarasi, and Bubu River basins and the Lake Victoria drainage system; and at least three undescribed species: *N.* spec. aff. *neumanni* "Malagarasi Type", *N.* spec. aff. *neumanni* "Mbeya Type", and *N.* spec. "Lake Victoria" (De Vos et al. 2001; Seegers 1997; Shidlovsky 2010; Wildekamp 1990, 2004).

Nothobranchius spec. aff. *neumanni* "Malagarasi Type" and *N.* spec. aff. *neumanni* "Mbeya Type" share with N. neumanni a unique combination of characters in male colour pattern: the caudal fin is red or partially red, the pectoral fins are hyaline, the anal fin is yellow with red stripes, its proximal portion light bluish grey. These synapomorphic colour characters are diagnostic for the *N. neumanni* species group.

In May 2008, the second author and Iva Ivanova (Dupnitsa, Bulgaria) collected during a *Nothobranchius* species survey specimens of *N.* spec. aff. *neumanni* "Malagarasi Type" from small pools in the drainage system of the Wulua River, which flows into the Limba Limba River. Based on these specimens we herein describe *Nothobranchius seegersi*, new species.

MATERIAL AND METHODS

Measurements and counts were taken as described in Amiet (1987), Huber (1992), and Valdesalici (2010). Measurements were made with a digital calliper, partly under a dissecting microscope, and rounded to the nearest 0.1 mm. If not stated otherwise, measurements are presented as percentages of standard length (SL), except for eye diameter and snout length, which are given as percentage of head length (HL). Terminology for the cephalic neuromast series follows Scheel (1968), for the frontal squamation Hoedeman (1958). Osteological preparations (clearing and staining, below: C&S) were made according to Taylor and Van Dyke (1985), but not stained for cartilages. We consider as *Nothobranchius neumanni* only the populations from the type locality in the Bubu River drainage (see fig. A50201–4 in Seegers 1997) and the geographically close Bahi Swamp area (see figs 5 a–b in Wildekamp 1990), which were also studied by Wildekamp (1990) in the redescription of the species. Morphological data from Wildekamp (1990) were used here for comparisons. Numbers in brackets following counts indicate the frequency of occurrence. Type material is deposited in the following institutions: Zoologisches Forschungsmuseum Alexander Koenig (ZFMK), Bonn, Germany, Museo Civico di Storia Naturale "Giacomo Doria" (MSNG), Genova, Italy, and Royal Museum for Central Africa (MRAC), Tervuren, Belgium.

RESULTS

Nothobranchius seegersi, new species
(Figs 1–2, Table 1)

Nothobranchius spec. aff. *neumanni*: Seegers (1997), p. 75, figs A50205–4
Nothobranchius neumanni: Wildekamp (2004), p. 206, population from south-west of Ipole.

Holotype. ZFMK 41848, 1 male, 44.5 mm SL, seasonal pool on the right side of the main road T8 from Ipole to Rungwa, near Mabangwe village, close by the bridge over the Limba Limba River, altitude 1114 m, Malagarasi River drainage, Tanzania, 5°59'1" S, 32°48'5" E, 2 June 2008, Kiril Kardashev and Iva Ivanova.

Fig. 1. *Nothobranchius seegersi*, adult male, not preserved, Tanzania, seasonal pool on right side of the main road T8 from Ipole to Rungwa, near Mabangwe village. Photo: Iva Ivanova.

Paratypes. ZFMK 41849- 41850, 2 females, 49.5 & 54.7 mm SL, same data as holotype; ZFMK 41851, 1 male, 45.9 mm SL, same data as holotype; MRAC 2010-33-P-1, 1 male, 43.8 mm SL, same data as holotype; MSNG 56046, 1 male, 57.5 mm SL, C&S, same data as holotype; MRAC 2010-33-P-2-3, 2 males, 42.5 & 44.3 mm SL, flooded grasslands on the right side of the main road T8 from Ipole to Rungwa, Mkola area, altitude 1107 m, Tanzania, 5°54'54" S, 32°45'54" E, Kiril Kardashev and Iva Ivanova, 2 June 2008; MSNG 56045A-B, 2 males, 36.6 & 38.1 mm SL, large pool on left side of the main road T8 from Ipole to Rungwa, near Ngoywa village, altitude 1114 m, Tanzania, 5°57'49" S, 32°46'50" E, Kiril Kardashev and Iva Ivanova, 2 June 2008.

Non-type material. Private collection of the first author: 1 male, 62.00 mm SL, C&S, same data as holotype.

Diagnosis. *Nothobranchius seegersi* males share with the other members of the *N. neumanni* species group a combination of colouration characters, which distinguish them from all other species of the genus: caudal fin red or partially red; pectoral fin hyaline; anal fin yellow with red stripes, proximal portion light bluish grey. It is distinguished from *N. neumanni* by bright light blue scales (vs. pale bluish grey), an irregular pattern formed by red scale margins on lateral body and head (vs. uniform), and a single, blue male colour morph (vs. two colour morphs, blue and red). Male and female *N. seegersi* have a relatively higher predorsal length compared to *N. neumanni* (60.3–68.8 (7) vs. 54.8–61.0 % (13) SL in males, 68.0–68.4 (2) vs. 57.1–64.6 % (24) SL in females). In osteological characters, *Nothobranchius seegersi* differs from *N. neumanni* by having a conspicuously longer lateral process of the post-temporal, and by having short antero-dorsal process of the urohyal (examined in 2 C&S *N. seegersi* and 5 *N. neumanni*).

Fig. 2. *Nothobranchius seegersi*, adult female, not preserved, Tanzania, seasonal pool on right side of the main road T8 from Ipole to Rungwa, near Mabangwe village. Photo: Iva Ivanova.

Description. See Figs 1–2 for overall appearance and Table 1 for morphometric data of the type series. Robust *Nothobranchius* with rounded body, maximum length recorded in males 62.0 mm SL. Dorsal profile straight to slightly concave on head, convex from nape to end of dorsal fin base. Ventral profile convex, slightly concave on caudal peduncle posterior to dorsal and anal fin. Snout slightly pointed, mouth directed upwards, lower jaw longer than upper, posterior end of rictus at same level as or slightly above centre of eye. Branchiostegal membrane projecting posteriorly from opercle. Dorsal and anal fin located far posterior, tips rounded with short filamentous rays. Both fins with papillate contact organs on fin rays. Dorsal fin tip reaching caudal fin. Number of dorsal fin rays 16–17, anal fin rays 17–18. Pectoral fin approximately triangular; in some specimens pectoral fins reach pelvic fins, and pelvic fins reach the anal fin origin. Caudal fin rounded.

Scales cycloid, body and head entirely scaled, except for ventral surface of head. Scales in median lateral series 28–34 + 3–5 on caudal fin base. Cephalic squamation pattern variable. Anterior neuromast series of the 'open' type. Central supra-orbital series in shallow grooves, each with

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Table 1. Morphometric data of *Nothobranchius seegersi*. Measurements except of standard length (in mm), eye diameter and head length (in percent of head length) are percentages of, standard length. Cleared and stained material is not included.

	Holotype	Males (n = 7)	Females (n = 2)
Standard length (mm)	44.5	36.6–45.9	49.5–54.7
Body depth at pelvic fin	29.2	28.9–33.8	29.2–29.2
Predorsal length	62.2	60.3–68.8	68.0–68.4
Preanal length	58.2	57.4–66.8	69.2–69.6
Prepelvic length	48.0	47.2–56.3	56.6–57.3
Caudal peduncle length	21.5	18.0–23.3	17.1–18.9
Caudal peduncle depth	13.2	13.2–16.2	13.7–13.9
Head length	30.7	30.7–36.0	34.7–35.7
Snout length	17.5	17.5–27.2	23.7–24.7
Eye diameter	27.0	22.2–27.0	18.9–22.0

two or three neuromasts. Posterior cephalic neuromast series curved with three or four neuromasts. One neuromast on each scale of median longitudinal series. Basihyal bone sub-triangular. Six branchiostegal rays. Vomerine teeth present in a large patch. Lateral process of post-temporal long. Single short antero-dorsal process of urohyal. Number of vertebrae 31–32. Premaxilla and dentary with many irregularly distributed unicuspid, slightly curved teeth of different size, a small number of larger ones on the outer row of upper and lower jaw. Females are smaller than males, maximum observed size 54.7 mm SL. In females, the dorsal fin is rounded, the anal fin is triangular with rounded tip. Branchiostegal membrane not projecting from opercle.

Colour in life. Males. (Fig. 1) Scales on body and head bright light blue with very thin and variable red margin, creating an irregular reticulated pattern on body and head. Branchiostegal membrane light blue with white margin. Dorsal fin grey greenish to grey bluish with with irregular rows of dark red spots proximally, which become elongate over fin rays distally. Anal fin bright yellow with light blue base, separated by a dark red narrow stripe or row of dark red irregular spots, and black margin. Some specimens with a median dark red narrow stripe or row of dark red irregular spots in anal fin. A sub-distal light blue narrow stripe present in anal fin of some specimens. Pelvic fins yellow with red spots. Pectoral fins hyaline with light blue margin. Caudal fin dark red, with black margin and light blue submargin. Iris golden, with faint black vertical bar through centre of eye.

Females. (Fig. 2) Scales on body and head pale greyish blue, with golden to light blue iridescence on scale centre. Opercular region silvery to golden. Abdomen silvery to golden. All fins hyaline. Iris golden, with faint black vertical bar through centre of eye.

Colour in ethanol. Males. Scales on body light brown to whitish, almost all scales on frontal and dorsal area with distinct dark red margin, ventral scales with irregular dark red spots. Dorsal fin whitish with dark red to brown spots. Anal fin pale yellowish with light brown to whitish base, separated by an irregular stripe formed by dark red to brown spots, black margin. Some specimens with a median dark red to brown narrow stripe or row of dark red irregular spots in anal fin. Pelvic fins yellowish with dark red proximal spots and distal black spots. Pectoral fins hyaline. Caudal fin dark red, with black margin and distinct yellowish submargin. Iris bluish.

Females. Body light brown to whitish. Opercular and ventral area yellowish. Unpaired and paired fins whitish. Iris bluish.

Etymology. The species is named in dedication to its first collector, the enthusiastic aquarist and ichthyologist Lothar Seegers, Germany.

Distribution and habitat. *Nothobranchius seegersi* is currently only known from seasonal pools in the drainage system of the Wulua and Mungu Rivers, Malagarasi River basin, central Tanzania (Fig. 3). The type locality was at the time of collection a small and very shallow pond, about 3 x 5 m wide and 0.25 m deep, without aquatic vegetation, in the open woodland (Fig. 4). The water was brown and very turbid. No other fish species was found in this pool.

DISCUSSION

Nothobranchius seegersi was collected for the first time in 1992 for aquaristic purposes, but apparently no material was deposited in public or institutional collections at

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Fig. 3. Geographic distribution of *Nothobranchius seegersi* (black rhomboids, open black rhomboid: type locality), *N. neumanni* (red rhomboids, open red rhomboid: type locality *N. neumanni*), and *N.* spec. aff. *neumanni* "Mbeya Type" (blue rhomboids). Map prepared by Béla Nagy.

that time. Until the new collections in 2008, only pictures were available (Seegers 1997). *Nothobranchius neumanni* was diagnosed in Wildekamp (1990) by the straight dorsal profile and marked, angular transition between head and body along the dorsal profile. The dorsal profile is however variable within *N. neumanni*, so we did not use this character for diagnosing the species described here.

Nothobranchius neumanni appears to be restricted to the Bubu River drainage and the Bahi Swamps. There are indications that the remaining populations so far assigned to *N. neumanni* (namely from the areas of the Chipongola, Manyara, Tabora, and Lake Victoria) differ substantially in terms of colouration, osteology, and genetics from the Bubu drainage and Bahi Swamp material (preliminary data from A Dorn & A Cellerino, Jena, pers. comm.), and might be considered as valid species; this is however beyond the scope of the present paper. Tanzania is with 21 out of the 44 currently recognized species the hotspot of *Nothobranchius* diversity (Wildekamp 2004), and further species descriptions from this region are to be expected.

COMPARATIVE MATERIAL

Nothobranchius neumanni: MSNG 56051A–B, 2 males, 52.7 & 57.3 mm SL; Seneki, Tanzania, 5°11'S, 33°17' E; MSNG 56052A-B, Sukamahela, Tanzania, 5°8'25" S, 32°46'44" E; 2 males, 37.9 & 47.8 mm SL. MSNG 56053, 1 male, 49,3 mm SL, C&S, Bahi Swamp – Lusilile TZ 2008-19, Tanzania, 5°53'S, 35°12' E; first authors private collection: 1 male C&S, 49.7 mm SL, Manyara area, Tanzania, 3°35' S, 35°50' E; 1 male C&S, 44.2 mm SL Tabora area, Tanzania, 5°1' S, 32°48' E; 1 male, 54.1 mm SL, Magiri, Tanzania, 4°55' S, 33°1' E; 2 males C&S, 47.8 & 52.8 mm, Bahi Swamp – Itigi, Tanzania, 05°53' S, 35°12' E; 1 male, 43.9 mm SL, Bahi Swamp-Lusilile, Tanzania, 5° 53' S, 35°12' E.

Fig. 4. Type locality of *Nothobranchius seegersi*, seasonal pool on right side of the main road T8 from Ipole to Rungwa, near Mabangwe village, Tanzania.

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Revisiting the species status of *Pecari maximus* van Roosmalen et al., 2007 (Mammalia) from the Brazilian Amazon

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Abstract. Three extant species of peccaries (Tayassuidae) are currently recognized and are distributed in the Americas: *Pecari tajacu, Tayassu pecari* and *Catagonus wagneri*. The recent claim for a new peccary species, *Pecari maximus*, raises questions about whether there is sufficient molecular or other evidence to support it as a new species. Here, we revisit that evidence using 91 published and 50 novel DNA sequences mainly from *P. tajacu*, as well as comment on the morphological and ecological evidence used to support such a claim. Phylogenetic analyses show that the single specimen of *P. maximus* used clustered within the South American lineage of *P. tajacu* closely related to Brazilian specimens. In addition, the morphological and ecological data used to claim the species status of *P. maximus* appears to be deficient and inconclusive, in the light of available literature.

Key words. Collared peccary, control region, mitochondrial DNA, *Pecari maximus*, *Pecari tajacu*, Tayassuidae.

INTRODUCTION

Three extant species of peccaries (Tayassuidae) are currently recognized: *Pecari tajacu* (Collared peccary), *Tayassu pecari* (White-lipped peccary) and *Catagonus wagneri* (Chacoan peccary) (Wetzel et al. 1975; Woodburne 1968; Wright 1989, 1993). These species have been identified according to morphological and cytogenetic parameters and more recently using DNA sequences. Classification has generally relied on biological concepts of reproductive and genetic isolation. One confounding factor is that *P. tajacu* and *T. pecari* are known to hybridize in captivity (Sowls 1997) and in the wild with the latter being reproductively sterile (Andrea et al. 2001). Cytogenetic studies have confirmed the existence of three species, showing significant chromosomal differences in number and structure: *P. tajacu* (2n=30), *T. pecari* (2n=26) and *C. wagneri* (2n=20) (Benirschke & Kumamo-

to 1989). Although chromosome painting across species (Bosma et al. 2004) has provided some chromosomal evolutionary insights into this family, a full understanding of the species relationships from a cytogenetic perspective remains hampered by a lack of information on *C. wagneri*. However, phylogenetic analyses of mitochondrial and nuclear DNA sequences have revealed that *T. pecari* and *C. wagneri* grouped in separate clades from *P. tajacu* (Gongora & Moran 2005; Theimer & Keim 1998). These conclusions obtained from molecular markers contrast with cladistic analyses of morphological data which proposed two different scenarios of relationships: First, *P. tajacu* and *C. wagneri* are more closely related whereas *T. pecari* is considered to be a member of a separate clade (Wright 1989, 1993, 1998); and second, *P. tajacu* and *T. pecari* are more closely related to each other than to the *C. wagneri* (Wetzel et al. 1975; Wetzel 1977).

The new species *Pecari maximus*. The recent claim of a new peccary species by van Roosmalen et al. (2007) raises questions about whether there is sufficient molecular and/or other evidence to recognise *P. maximus* as a new species. The morphological and genetic evidence used by van Roosmalen et al. (2007) to support the species status for *P. maximus* appears to be controversial. They analysed a small number of specimens from deceased animals (five skins and three skulls, two of which were from adults), and the body weight (40–50 kg) and size of the animals (total body length 127 cm; ear length 13 cm; shoulder height 85 cm) were estimated from reports and photographs by local hunters. Morphometric analyses were also estimated from skin measurements, and they relied on pelage colour to point the differences with other species. In this study, the mitochondrial control region and two nuclear SINE PRE-1 sequences of a single individual were used to assess the phylogenetic position of *P. maximus* among recognised species of peccaries. In addition, van Roosmalen et al. (2007) used morphological and behavioural data to support a separate status for those peccaries. These authors argue that in contrast with the other peccary species, which they suggest roam semi-nomadically in a highly variable landscape in a noisy herd, *P. maximus* appears to walk silently through its habitat in small family groups that contain a single adult pair with or without 1–2 offspring. They also claim that *P. maximus* performs little or no uprooting and has been seen feeding mainly on freshly fallen fruits and seeds exposed on the forest floor, which appears to be result of direct observations. The claim by van Roosmalen et al. (2007) underlines the urgent need to complete an ongoing modern taxonomic assessment of the family Tayassuidae. A revision of the peccaries is imperative to orient conservation management and planning as well as to increase understanding of the basic biology, ecology and evolution of this group (Taber 1993).

Differentiation within *P. tajacu*. Highly relevant to the claim by van Roosmalen et al. for a fourth species in the genus *Pecari* is that previous phylogenetic mitochondrial DNA studies have shown genetic variation within Collared peccary to be higher than that observed between *C. wageneri* and *T. pecari*, and was also higher than that observed between recognised species of the family Suidae (Gongora & Moran 2005; Gongora et al. 2006). Phenotypic, morphological, chromosomal and DNA data have been used to assess the levels of differentiation within *P. tajacu*. This lineage has a broad distribution in the subtropical and tropical ecosystems of the Americas comprising a wide variety of environments (rainforest, semi-arid thorn forest, coastal forest, cloud forest, deserts, islands, rangelands, scrublands, savannas, and freshwater wetland) between the south-western United States of America and northern Argentina (Grubb & Groves 1993). Its ancestry also seems to have an early divergence from the other peccary lineages in the Americas (Gongora et al. 2006). Early morphological studies provided the first evidence of cranial and dental variation between *P. tajacu* from throughout the Americas (Kiltie 1985; Woodburne 1968), although specimens were ultimately grouped into a single species. Variations in size and pelage colour, coupled with distribution data, have been the basis for proposing the existence of 14 subspecies of *P. tajacu* (Grubb & Groves 1993; Hall 1981). However, the inheritance of these traits has not been tested or substantiated by other methods.

Conventional cytogenetic (Builes et al. 2004; Gongora et al. 2000; Vasart et al. 1994) and cross-species chromosome painting (Adega et al. 2006; Bosma et al. 2004) studies showed variation in the structure of two chromosomes between *P. tajacu* specimens from Arizona, Colombia and Brazil, providing additional evidence for differentiation within this species. A single captive specimen from Colombia, heterozygous for a balanced translocation may represent a hybrid between the two different *P. tajacu* lineages (Builes et al. 2004). This may contrast with other cytogenetic studies (Adega et al. 2006) which propose a 'significant barrier' for hybridization between major Collared peccary lineages/species. However, germ line cytogenetic and/or reproductive studies are required to assess whether this possible hybrid is fertile before any conclusion can be addressed.

In this paper we revisit the genetic data from *P. maximus* (van Roosmalen et al. 2007) using a DNA dataset of the three peccary species generated by Gongora et al. (2005, 2006) and including 50 new DNA *P. tajacu* sequences from United States, Mexico, Colombia and Brazil. We also analyse the morphological and ecological evidence used to support the species status of *P. maximus* in the light of available literature.

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MATERIAL AND METHODS

Sampling and DNA extraction. Blood, tissue and hair samples from 50 captive and wild *P. tajacu* from south-eastern and central-western Brazil (BRA1–BRA5; *n*=5); southern and northern Colombia (COL11–COL40; *n*=30); central and southern-central Mexico (MEX41–MEX48; *n*=8); and Texas in the United States (USA6–USA12; *n*=7) were used in this study (Appendix I). DNA was extracted using either a standard proteinase K and phenol-chloroform protocol (Sambrook et al. 1989) or QIAamp DNA mini kits (Qiagen Pty Ltd).

PCR and Sequencing. We used previously published primers to amplify approximately 1,200 bp of the complete mitochondrial control region (Kim et al. 2002) at the University of Sydney, Australia. PCR was carried out using methods outlined in Gongora et al. (2005; 2006) except for sequencing of forward and reverse strands which were directly sequenced rather than clone inserts. Control region sequences (450 bp) from the Texan specimens (n=7) were independently generated at Purdue University. Primers, PCR and sequencing conditions were performed as described in Cooper et al. (2010). Although there is a difference in length between the above subsets of sequences, the corresponding regions are informative for assessing the major clades of *P. tajacu* described in previous studies (Gongora et al. 2006).

Data analysis. Forward and reverse sequences were overlapped in order to obtain a single double-stranded sequence for each animal using CodonCode Aligner v3.5.5 (CodonCode Corporation). After excluding flanking primer regions, the novel sequences (~1,120 bp, GenBank accession numbers HM102371 through HM102419) were aligned using the program Muscle (version 3.6; Edgar, 2004) along with those *P. tajacu* sequences (AY546539–AY546569) published by Gongora et al. (2005; 2006) and the single sequence (DQ009006) from *P. maximus* published by van Roosmalen et al. (2007). The control region from *T. pecari* (AY546516–AY546519) and *C. wagneri* (AY546520, AY546521) were included as an outgroup. The alignment used for analyses described consisted of 1,140 bp after excluding the tandem repeat motifs, except for a single motif, due to heteroplasmy according to Gongora et al. (2006). Because few gaps were observed they were kept in the alignment.

A separate dataset of concatenated nuclear PRE-1 642 and PRE-1 27 sequences was generated and aligned as described above. It consisted of available sequences from GenBank (*P. maximus*, DQ016372 and DQ016371; *P. tajacu*, DQ190931–DQ190883, AY569340–AY569339, and AY568052–AY568047; *T. pecari*, AY546331 and AY546528; and *C. wagneri*, AY546530 and AY546527). The best fit DNA substitution model for the control region and PRE-1 alignments were selected by the program Modelgenerator (version 0.85; Keane et al. 2006) and implemented in Maximum Likelihood (ML) to reconstruct a phylogenetic tree using the software PhyML (version 3.0; Guindon & Gascuel 2003). The tree topology space was searched by using the best of Nearest Neighbour Interchange and Subtree Pruning and Regrafting starting from five random starting trees generated by BioNJ (Guindon & Gascuel 2003; Guindon et al. 2010). Branch support was calculated using the approximate likelihood ratio test (aLRT) with SH-like interpretation, as it is as conservative and accurate test compared with bootstrapping but less computationally intensive (Anisimova & Gascuel 2006; Guindon et al. 2010).

RESULTS AND DISCUSSION

Clustering of P. maximus within recognised major clades of P. tajacu. Novel and published Collared peccary mitochondrial control region sequences representing 44 haplotypes clustered in two major clades: North/Central American clade and South American clade (Fig. 1) as described by Gongora et al. (2006). The novel *P. tajacu* sequences from Brazil clustered within the South American clade closely related to two sequences from Argentina, while those from Texas clustered within the North/Central American clade closely related to specimens from Arizona, Mexico and Colombia. Sequences from Colombian specimens split between the two major clades consistent with previous studies of being a paraphyletic group (Gongora et al. 2006). The current results corroborate that the Gongora et al. (2006) dataset is suitable for assessing major subcontinental geographical origins of captive and wild specimens.

Unexpectedly for a sequence from what is considered as a different species, *Pecari maximus* clustered within the major South American clade closely related to central-western Brazilian and northern Argentinean sequences supported by high aLRT values (Fig. 1) rather than in a separate new clade. Consistent with control region analyses, ML tree of PRE-1 sequences shows that those from *P. maximus* cluster within the *P. tajacu* closely related to sequences from Bolivia, Colombia and the United States (data not shown). The clustering of *Pecari maximus* within a previously recognized South American clade of *P. tajacu* (Gongora et al. 2006) do not support the new species status of those specimens studied by van Roosmalen et al. (2007). Although there is no agreement as to which particular sequences accurately and universally reflect the species' boundaries (Vogler & Monaghan 2007), other molecular markers, such as cytochrome *b* or cytochrome *c* oxidase *I* are usually recommended as being more inform-

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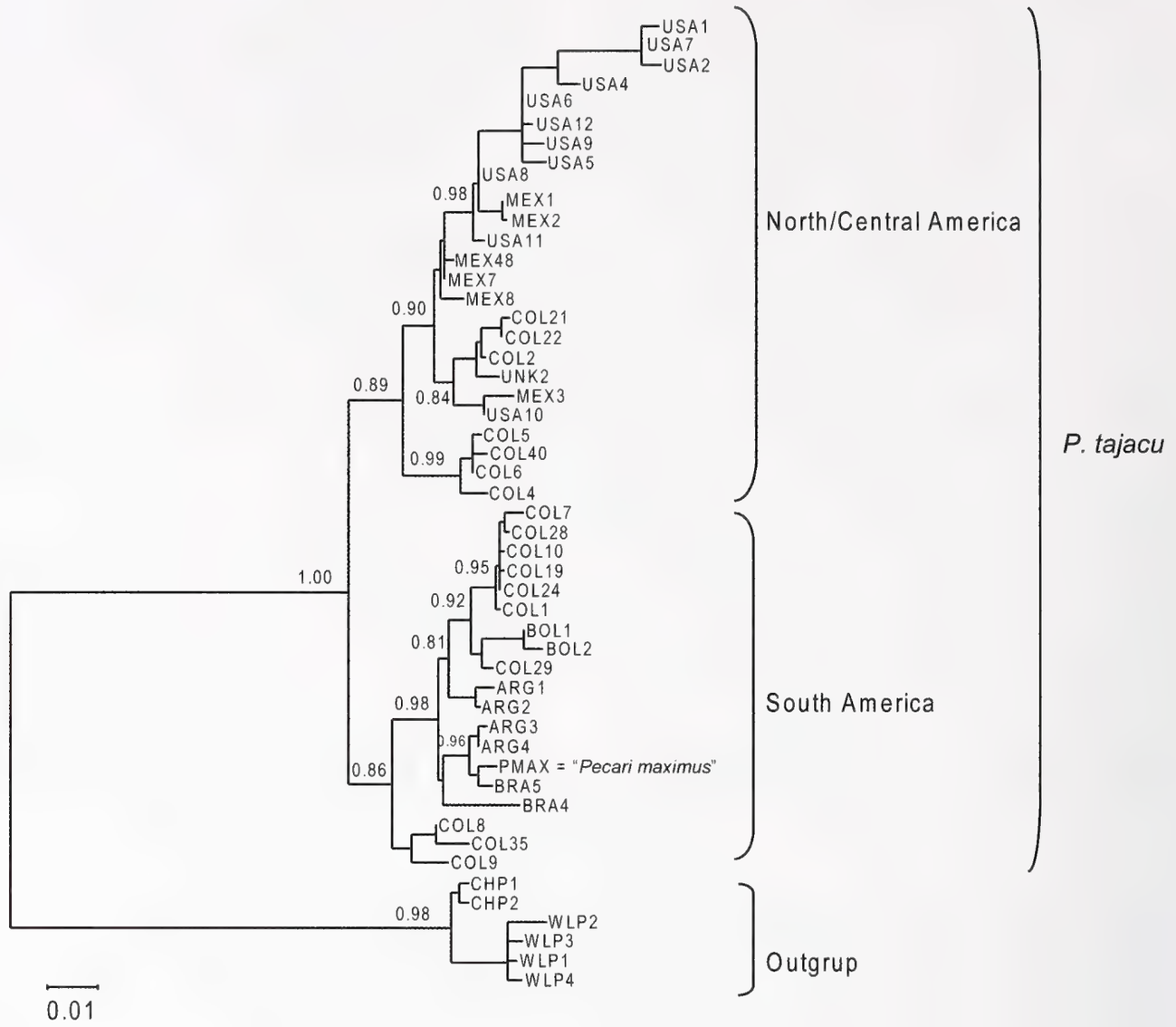

Fig. 1. Maximum Likelihood tree of the mitochondrial control region sequence representing forty-four haplotypes observed in eighty *P. tajacu* specimens, using both *C. wagneri* (CHP) and *T. pecari* (WLP) sequences as outgroups. Brackets indicate the two major clades found in *P. tajacu* with Colombian (COL) specimens showing paraphyletic relationships. *Pecari maximus* clustered within *P. tajacu* closely related to those specimens from Brazil (BRA) and Argentina (ARG). Details of samples used in this study are described in Appendix 1. Numbers close to branches are aLRT values. For clarity, only aLTR values for the main internal groups higher than 0.80 are shown.

ative to assess genetic species distinction (Blaxter 2004; Blaxter et al. 2005; Bradley & Baker 2001). Phylogenetic conclusions based on a single specimen are insufficient and uncertain. Under the current DNA evidence it is likely that single specimens studied by van Roosmalen et al. (2007) correspond to one of the *P. tajacu* lineages identified by Gongora et al. (2006). Species status has come and gone for some putative taxa within the distantly related suid family. For instance, the possible extinct *S. buculentus* (Indochinese or Vietnam Warty pig) was initially considered as a separate species within the genus *Sus* (Groves 1997), but after DNA analyses showed that its sequences clustered closely with *S. scrofa* (domestic pig and wild boar), it has been suggested that it could correspond to a geographically restricted variant of *S. scrofa* rather than a distinct species (Mona et al. 2007; Robins et al. 2006).

Comments on the morphological, behavioural and ecological evidence of *P. maximus*. The body weights reported for *P. maximus* (van Roosmalen et al. 2007) are within the range reported for *P. tajacu*, albeit at the large end. For instance, Sowls (1997) reports exceptional weights of wild Collared peccaries in Arizona in excess of 42 kg, and Bodmer (1989) reports weights close to 40 kg in Peru. Bodmer et al. (pers. obs.) have observed considerable variation in the skull sizes of both *P. tajacu* and *T. pecari* from the Tahuayo, Yavari and Tamshiyacu regions of north-eastern Peru, well within the range reported by van Roosmalen et al. (2007). These preliminary observations are based on the collection held at the zoology museum of the Universidad Nacional de la Amazonía Peruana (UNAP), which consists of several thousand skulls collected by local subsistence hunters over a 10 year period. In addition, Bodmer et al. (per. obs.) have recorded body weights from both *P. tajacu* and *T. pecari* hunted by local people in the Yavari river valley. Again, there is considerable variation, and the body weights are well within the range reported by van Roosmalen (Bodmer pers. obs.). Comparing *T. pecari* with the proposed new species, the former may similarly reach head-body lengths over 120 cm and weights as high as 40 kg in the Brazilian Pantanal (Keuroghlian et al. 2006) and 50 kg in the northern Amazon (Fragoso 1998). It would be desirable that skull measurements of the proposed *P. maximus* be statistically compared with those from extremely large *P. tajacu* found elsewhere in their range. Further, using skin pelage characteristics to distinguish species can be problematic since bristle colour may differ substantially within peccary species even in the same area (Gongora et al. 2006). In Collared peccaries, their lighter-haired collar pattern may vary from distinct in some individuals to barely noticeable in others. The most compelling morphological lines of evidence presented by van Roosmalen et al. (2007) are three photographs from three individuals of exceptionally long-legged peccaries which appear different from peccaries we are familiar with, but these are not backed up by measurements.

Ecological and behavioural differences have also been used to characterize peccary species (Sowls 1997). van Roosmalen et al. (2007) have attributed a number of differentiating traits for their peccary in line with this reasoning. However these claims are not based on intensive field observations, nor do they draw on recent literature concerning the ecology and behaviour of both *P. tajacu* and *T. pecari* to inform contrasts. For instance, while they claim that the new peccary uniquely lives in adult pair groups, sometimes with young, *P. tajacu* is also known to forage alone or in small groups, even while belonging to herds typically of six to twelve individuals (Keuroghlian et al. 2004; Sowls 1997; Taber et al. 1994), although larger groups have been reported from the Amazon (Fragoso 1994). Furthermore, the number of individuals seen together may depend on the time of day. Radio telemetry studies have shown that *T. pecari* has distinct seasonal movements that are related to habitat and fruit availability within their large home ranges, and *P. tajacu* has relatively small stable home ranges (Altrichter et al. 2001; Fragoso 1998; Keuroghlian et al. 2004; Keuroghlian & Eaton 2008; Sowls 1997). Neither species can be described as roaming semi-nomadically as van Roosmalen et al. (2007) has suggested. Instead they commonly forage on freshly fallen fruits (Altrichter et al. 2000, 2001; Beck 2005; Keuroghlian & Eaton 2008). Therefore, these are not unique behaviours of *P. maximus*. Whether peccaries need to dig with their noses during foraging depends on the type of habitat where fruits are available, i.e. buried within the sediments of a swamp or exposed on the forest floor (Keuroghlian & Eaton 2008). With only three skulls attributed to the new species, sample size is too low to comment on tooth wear patterns. Also, the lack of scent from the new peccary skins may be related to the skill of the hunters (that remove scent glands during butchering; Keuroghlian pers. obs.). We note that subjectively there seems to be a considerable range between species and individuals with Chacoan peccaries having the least intense scent which may contribute to them being harder for the dogs of local hunters to track (Taber et al. 1993). Finally, observations are too limited, and overly dependent on local hunter hearsay, to draw conclusions that this possible new species has abandoned social groupings, group defence and territorial scent marking.

The possible discovery of a new peccary species from the Amazon basin is very exciting, and plausible, considering recent discoveries of new mammal species in this region mainly by van Roosmalen et al. (1998, 2000, 2002, 2003). However, based on the scant information reported by van Roosmalen et al. (2007), and the results of our own genetic analysis, we conclude that there is not enough evidence to support the claim of a new species, and that the specimens studied by van Roosmalen are most likely *P. tajacu*. We also consider that further DNA, cytogenetic and morphological research is necessary to better understand peccary taxonomy. Additional studies using other genetic molecular markers, cytogenetic, and morphological analyses incorporating new samples from all across the Amazon basin, will provide the basic information for understanding the genetic and morphology variation under the extant recognized species.

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cary samples were sourced from wild and captive specimens collected for other studies from J. Gongora and J.D. Cooper. We thank Peter Waser and J. Andrew DeWoody for their support to J.D. Cooper to access the Collared peccary sequences from Texas. We also would like to thank all the institutions that collaborated in obtaining samples listed in Appendix I.

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Appendix I.

Origin of Collared peccary samples

Argentina: North, Ciudad de Rio Cuarto ARG1–2; Olavarria, ARG3–4; **Bolivia**: North, La Paz, Mallasa Zoo, BOL1–2. **Brazil**: State of Amazonas, PMAX; South East, State of São Paulo, BRA1–4; Central West, State of Mato Grosso do Sul, BRA5. **Colombia**: Central, Santa Cruz Zoo, COL1; Jaime Duque Zoo, COL2; North Central, Matecaña Zoo, COL4, COL20–22; Santafe Zoo, COL5; North West, Barranquilla Zoo, COL6, COL30–40; South Central, La Lagartija Zoo, COL7; La Lagartija Zoo, COL8; Cali Zoo, COL9; South East, Macagual Farm, COL10, COL23–29; Central, Santa Cruz Zoo, COL11–19; **Mexico**: Central, Guadalajara Zoo, MEX1–2; North, Puebla Zoo, MEX3–4, MEX41–42; South Central, Mexico DF Zoo, MEX5–8, MEX43–48. **USA**: Arizona, USA1–3; Texas, USA4–12. **Unknown**: Adelaide Zoo, UNK1–2.

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Two new species and a new record of the genus *Neolindus* Scheerpeltz, 1933 (Coleoptera: Staphylinidae: Paederinae)

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Abstract. The two new species *Neolindus verhaaghi* from Peru and *Neolindus pastazae* from Ecuador are described. A new record from central Amazonia of *Neolindus densus* Herman, 1991, is presented.

Key words: Paederinae, new species, Ecuador, Peru, new record, central Amazon.

Resumen: Las dos especies nuevas *Neolindus verhaaghi* de Peru y *Neolindus pastazae* de Ecuador están descrito. Uno lugar nuevo de Amazonica Central de *Neolindus densus* Herman, 1991, está presentado.

Palabras clave: Paederinae, especie nueva, Ecuador, Peru, lugar nuevo, Amazonica Central.

INTRODUCTION

The genus *Neolindus* is restricted to Central and South America and distributed from Bolivia and southern Brazil in the south to Costa Rica in the north. Ecuador is the most species-rich country with 10 species. The first species was described by Sharp (1876) as *Lindus religans* Sharp, 1876. Later, Scheerpeltz (1933) renamed the genus *Neolindus,* since the name *Lindus* was already preoccupied. Irmler (1981) added five new species from Brazil and Peru, and Herman (1991) published a review of the genus, added 27 species, and published a cladistic analysis of the genus together with *Cylindroxystus* Bierig, 1943. Thus, the genus contained 33 species in the Neotropical region.

In 2009, I collected a new species of the genus in the Rio Pastaza basin, Ecuador. Earlier, I had found a further new species in the collection of my colleague Manfred Verhaagh, Natural History Museum in Karlsruhe, Germany. Inferred from the low number of specimens found, all species seem to be very rarely collected. Most species have been described by only one specimen. The two new species are also known by only one specimen. Overall, 72 specimens have been collected in the Neotropics. Therefore, a new record of *N. densus* Herman, 1991 found near Manaus in the central Amazon basin is also published, here.

MATERIAL AND METHODS

The new material is deposited in my private collection (UIC).

For the photographs, a Makroskop M 420 (Wild, Herbrugg) was used in combination with a digital camera (Nikon D100). Head length was measured from anterior edge of clypeus to posterior edge of head disc, pronotum along the midline from anterior edge to posterior edge, elytra from anterior edge of shoulders to posterior edge; width was measured at the widest part of tagmata. In the measurements of total length, the abdominal inter-segmental space is subtracted.

RESULTS

Neolindus verhaaghi, new species

(Figs 1 A–H)

Holotype. Male; Peru; Huanuco, Panguana, 150 km SW Pucallpa, tropical rain forest, pitfall trap, 2.–16.7.1984, leg. M. Verhaagh, #pWA65 (UIC).

Diagnosis. The species is attributed to the group of *N. agilis* Herman, 1991 and *N. densus* Herman, 1991. The central emargination of the 8th sternite [Fig. 1 F] is similar

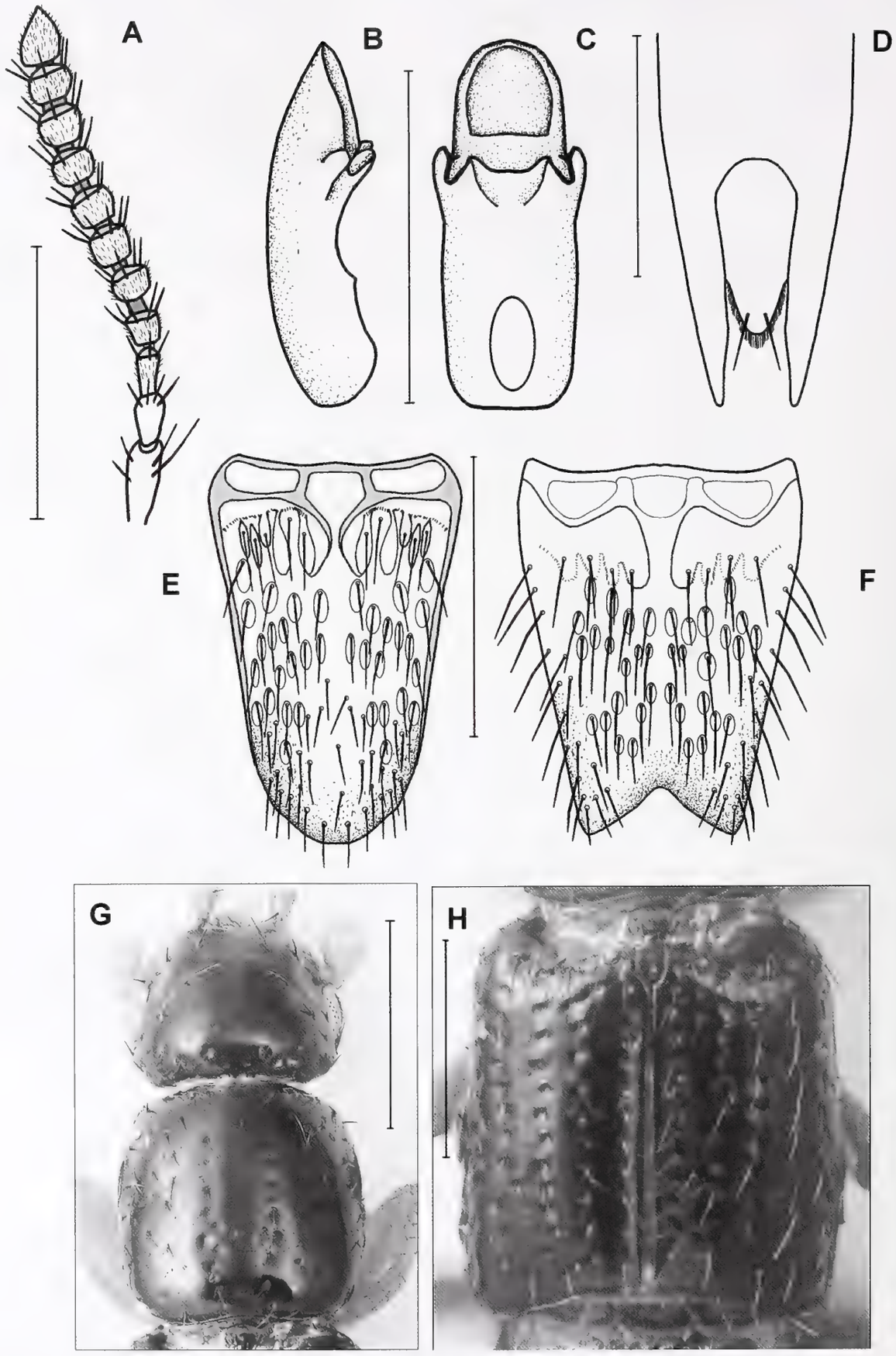

Fig. 1. *Neolindus verhaaghi*; antennae (A), aedeagus in lateral (B) and ventral (C) aspect, 7th and 8th visible tergites (D), 6th visible tergite (E) and sternite (F), dorsal aspect of head and pronotum (G) and elytra (H) showing punctation and surface (scale bar 0.5 mm).

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to *N. densus* Herman, 1991 [Fig. 131 in Herman 1991] and *N. cephalochymus* Herman, 1991 [Fig. 139 in Herman 1991]. Antennomere 2 [Fig. 1 A] is slightly shorter than 3, whereas it is slightly longer in *N. densus* and *N. cephalochymus*. Furthermore, the penultimate antennomeres in *N. densus* are wider than they are long, but more or less quadrate in *N. verhaaghi*. As in *N. agilis* [Fig. 147 in Herman 1991], *N. verhaaghi* has no dense patch of setae on the 8th sternite [Fig. 1 F]. The apical emargination on the 8th sternite is deeper in *N. verhaaghi* than in *N. agilis,* and the aedeagus has an apical cavity [Fig. 1 B, C] which is absent in all related species.

Description. Length: 4 mm. Colour: red, legs, antennae and posterior edge of tergites yellow. Head: 0.50 mm long, 0.55 mm wide; eyes as long as temples, temples rounded in smooth curve without forming angles; extremely fine micro-punctation and without microsculpture; surface shiny; one trichobothrium and one setiferous puncture at front edge of eyes; two setiferous punctures on disc between eyes [Fig. 1 G]; distance between these punctures slightly wider than between upper edge of eye and adjacent puncture; transverse row of punctures at posterior edge of vertex, and two diagonal rows of punctures between eyes and posterior edge of vertex. Antennae as long as head and pronotum; 3rd antennomere slightly longer than 2nd antennomere [Fig. 1 A]; 4th antennomere slightly longer than wide; following antennomeres more or less quadrate, pubescent and with few apical setae. Pronotum: 0.65 mm long, 0.60 mm wide; with longitudinal row of 11–12 punctures on each side of smooth midline [Fig. 1 G]; several punctures on laterad to paramedial row of punctures; distance between these punctures at least as wide as diameter of punctures; surface without microsculpture, polished and shiny. Elytra: 0.75 mm long, 0.65 mm wide; with sutural row of 11–12 punctures and three more rows on disc [Fig. 1 H]; two rows of irregular punctures laterad to disc. Abdomen densely punctate; anterior segments distinctly more densely punctate than posterior segments; 8th tergite apically rounded [Fig. 1 E]; 8th sternite [Fig. 1 F] with triangular emargination, central impunctate stripe, and without clusters of setiferous punctures. Aedeagus with apical cavity and lateral truncate prominences behind cavity [Fig. 1 B, C].

Etymology. The specific name refers to the collector of the species, Manfred Verhaagh, from the Natural History Museum in Karlsruhe, Germany.

Neolindus pastazae, new species
(Figs 2 A–I)

Holotype. Male; Ecuador, Tungurahua, 10 km W of Baños, valley of Rio Pastaza, path near waterfall "Manto de la Novia" (78°20.16W, 1°24.12S), sifting litter, 28.7.2009, leg. U. Irmler (UIC).

Diagnosis. *Neolindus pastazae* is certainly closely related to *N. punctogularis* Herman, 1991, as determined by the transverse cluster of numerous setae at the apical edge of the gula. It can be easily differentiated from *N. punctogularis* by the darker colour of head and pronotum and the different punctation of pronotum [Fig. 2 H]. The last abdominal tergites and sternites [Fig. 2 E, F, G] are very similar to *N. punctogularis* Herman, 1991 [Figs 205–207 in Herman 1991]. Besides the development of the transverse row of numerous setae at the anterior edge of the gula, both species can be differentiated from *N. schubarti* Irmler, 1981, *N. religans* Sharp, 1876, and *N. bidens* Herman, 1991, since the latter are carinate on 8th sternites or have a ridge at the posterior edge [Figs 211, 220, 223 in Herman 1991].

Description. Length: 10.5 mm. Colour: brown, antennae, palpae and legs yellow. Head: 0.90 mm long, 1.5 mm wide; with eyes slightly prominent [Fig. 2 H]; temples 1/4 as long as eyes; temples obtusely angled to posterior edge, outer part of posterior edge transversely narrowed to neck; labrum with pair of apically rounded denticles near the middle, with five setae at anterior edge; disc with fine micro-punctation; surface polished; two large punctures on each side of vertex between eyes; distance between these punctures wider than between each puncture and adjacent eye; few setiferous supraocular punctures; central puncture with trichobothrium; row of setiferous punctures along posterior edge; supraocular punctures and posterior row of punctures smaller than two large punctures between eyes, but much larger than micro-punctures; gula with transverse row of numerous setae near anterior margin. Antennae with first antennomere elongate and as long as antennomeres 2 and 3 combined [Fig. 2 A]; 2nd antennomere short, only 1/3 as long as 3rd antennomere; following antennomeres elongate and decreasing in length; antennomeres 3 to 11 pubescent. Maxillary palp at 2nd segment with several long setae at inner side. Pronotum: 1.35 mm long, 1.65 mm wide; with sides more or less parallel in anterior half [Fig. 2 H]; in posterior half, smoothly rounded to posterior edge without forming angle; margin continuing from posterior edge to anterior edge and covered by anterior angles in dorsal aspect; disc polished and shiny; irregular row of 11 to 12 punctures on each side of smooth midline; two transverse rows laterad to paramedial rows of punctures and few scattered punctures laterad. Elytra: 1.95 mm long, 1.85 mm wide; surface polished and shiny; with irregular rows of dense punctures [Fig. 2 I]; average distance between punctures distinctly narrower than half diameter of punctures; partly coriaceous. Abdomen densely and deeply punctate; anterior tergites more densely punctate than posterior tergites; 8th tergite trilobed

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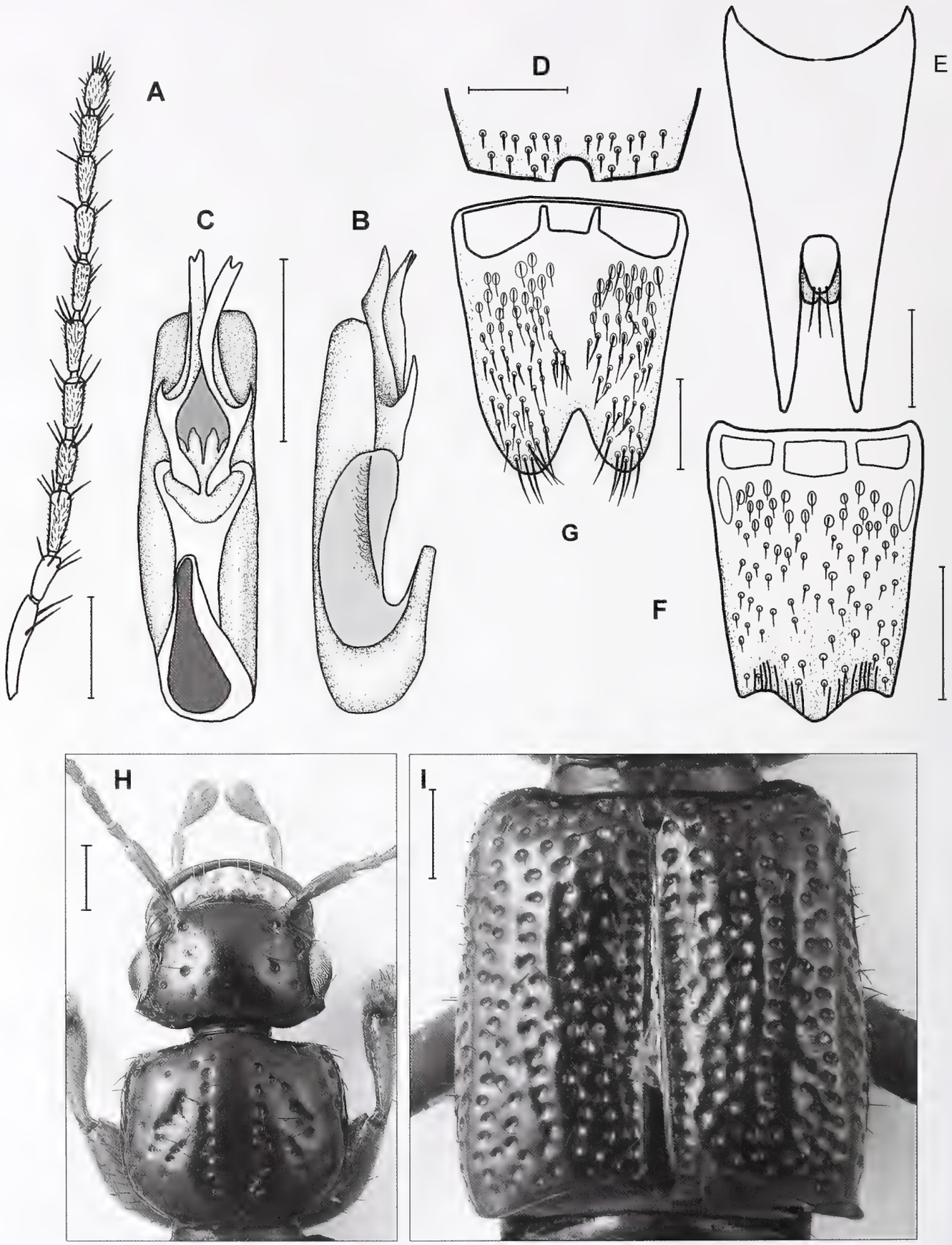

Fig. 2. *Neolindus pastazae*; antennae (A), aedeagus in lateral (B) and ventral (C) aspect, 5th visible sternite in ventral aspect (D), 7th and 8th visible tergites (E), 6th visible tergite (F) and sternite (G), dorsal aspect of head and pronotum (H) and elytra (I) showing punctation and surface (scale bar 0.5 mm).

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with triangular central prominence and with striate structures at posterior edge [Fig. 2 F]; 7th sternite with semicircular emargination at posterior edge [Fig. 2 D]; 8th sternite with deep central emargination and glabrous central stripe [Fig. 2 E]. Aedeagus slightly asymmetric, with two long bifurcate prominences apically and one pair of hooks in apical half [Fig. 2 B, C]; ventral surface with deep cavity in paramedial position.

Etymology. The specific name derives from the location in the valley of the Rio Pastaza where it was found.

Neolindus densus Herman, 1991

New record. Brazil, Amazonas, 15 km SW Manaus, on Ilha de Marchanteria (59°55.21W, 3°13.59S), inundation forest in Varzea, tree eclector #50E, 1 male, 1 female, 18.2.1982, leg. J. Adis (UIC).

DISCUSSION

Together with the two new species the total number of *Neolindus* species increased to 35 species with Ecuador (11) and Peru (7) as countries with high numbers of species. Only Brazil, which has a much larger area than these two countries, has a similarly high number with nine species. The species have been very rarely collected. As *N. densus* Herman, 1991 shows, the distribution can nevertheless cover a wide area. This species seems to occur along the Amazon valley from its mouth near Belém to the Andean foot hills near Leticia (Columbia). A more detailed analysis of the ecology is difficult. According to the information given by Herman (1991) many species have been found in leaf litter of rain forests. In some labelled information the habitat was described as "under felled tree". The habitat of *N. pastazae* was also in litter layer under a felled tree. The collection of *N. densus* Herman, 1991 by a tree eclector in the central Amazon basin suggests that the tree habitat might be a more important habitat than can be derived from the labelled information. Thus, soil litter layer might be only an accidental habitat of the normally inhabited tree trunks, which are rarely investigated.

According to Herman (1991), the *Neolindus* species can be separated more or less in three species groups which are closer related. *N. verhaaghi* can be attributed to clade (17) with *N. punctventris, N. densus, N. agilis, N. cephalochymus, N. bullus, N. hamatus, N. procarinatus,* and *N. retusus*. This group is characterised by the presence of parallel carinae at the base of sternum VIII. The species of this group are distributed over the whole equatorial region, from the lowland rain forest of the Amazon basin to the western rainforest in Ecuador. *Neolindus pastazae* seems to be related to clade (24) with *N. punctogularis*, *N, hangarthi*, *N. schubarti*, *N. bidens*, and *N. religans*. In this group, species are characterised by a pronotum wider than it is long and tergum VIII being trilobed. Whereas *N. religans* and *N. schubarti* are distributed in eastern Brazil, *N. bidens*, *H. hanagarthi*, and the new *N. pastazae* represent a western branch of this group.

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A remarkable record of *Phaneroptera falcata* (Poda, 1761) (Saltatoria: Phaneropteridae) from north-eastern Poland

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Abstract. A record of *Phaneroptera falcata* is made from the northeastern Poland, extending the known distribution in this country for about 300 km to the north and linking it with a newly discovered occurrence in southern Lithuania. The northern margin of the species' range in eastern Central Europe and in East Europe is briefly reviewed.

Phaneroptera falcata (Poda, 1761) belongs to those faunal elements which underwent a rapid northward-directed range extension on the northwestern edge of their distribution areas, particularly in NW Germany (Northrhine-Westphalia) and the Benelux countries (Detzel 1998). A similar trend was observed in Thuringia (Köhler, 2010), and even the federal states of Lower Saxony and Brandenburg have already been reached (Grein 2000, 2007, Landeck et al. 2005). In the eastern part of its Central European range, however, *P. falcata* was believed, despite some expansional trend in the Czech Republic (Kočárek et al. 2008), to be restricted to the southern half of Poland, as indicated by e.g. the sketch maps in Detzel (1998) and Maas et al. (2002). However, a recent record in southernmost Lithuania (Lazdijai) close to the Polish northeastern border (Ivinskis & Rimsaite 2008) suggests a much more northern distribution also in Poland.

Southern Poland (Galicia) had already been mentioned in the classic work by Harz (1957) as that part of this country which is inhabited by *P. falcata.* Even much earlier, Zacher (1917) had pointed on a doubtful voucher specimen of the Wroclaw (formerly Breslau) Museum from "Schlesien" (= Silesia), but he claimed that Pylnov (1913) had already recorded this species more northernly of Wroclaw, viz. from "Nova Alexandria, Russisch Polen" (= "Russian Poland"). This place, today Pulawy (51.26N; 21.59E) can be found on older maps as situated between Radom and Lublin, on the Visla river south of Deblin: 51.34N; 21.50E. Several new Polish references give a more detailed and also extended picture of the distribution range of *P. falcata* in Poland (Bazyluk & Liana 2000, Kočárek 2000, Orzechowski 2009). The locality data published by these authors document this species to be more widespread in the central part of Poland, the most northwestern records (Lubuskie Province: Orzechowski 2009) being adjacent to the relatively new records from Brandenburg (Landeck et al. 2005). The two northern Polish regions Pojezierze Pomorskie and Mazurskie which together roughly comprise the northern third of the country, were so far lacking *Phaneroptera falcata* records. The new and unexpected find of this species in southern Lithuania (Ivinskis & Rimsaite 2008), however, made the occurrence of *P. falcata* likely also in northern Poland .

On August 13, 2010 two of us (WB & PW) passed through northeastern Poland towards Lithuania. On road no. 16 east of Wigierski National Park, between Serski Las village and Sejny, at 53.55N and 23.09E, when searching for lizards on a spruce forest clearing, we happened to find an adult female of *P. falcata* (Fig. 1) which in view of what is said above seems to be a remarkable record, as it ex-

Fig. 1. The voucher specimen of *Phaneroptera falcata* from E of Wigierski National Park, Northeast Poland. Photograph: P. Geissler.

Fig. 2. Habitat east of Wigierski National Park where our *P. falcata* record was found. Photograph: W. Böhme.

tends the known range within Poland for about (appr.) 300 km northeastwards and immediately links it with the first Lithuanian record from 2008. The locality (Fig. 2) is situated less than 20 km from the Lithuanian border and closely corresponds to the new and single Lithuanian locality of this thermophilous species which is situated in the Lazdijai district at 54.12N and 23.50E (Ivinskis & Rimsaite 2008) (Fig. 3). Our specimen is deposited in the Orthoptera collection of the Zoologisches Forschungsmuseum A. Koenig (ZFMK) in Bonn.

According to Zuna-Kratky et al. (2009), adults in Austria appear about on mid-July but start their main adulthood season from mid-August. This agrees with our female voucher specimen, which was also adult, despite its much more northernly situated locality.

Road no. 16 from Augustow via Serski Las and Sejny runs in parallel to the main road (no. 8, via Suwalki to Marjampole in Lithuania) and has much less traffic than the latter. This alone makes it unlikely that the specimen of *P. falcata* could have been passively displaced by human transportation. Rather, this thermophilous species demonstrated its potential for a natural, northeastward-directed range extension not only in Germany and the Benelux countries with a predominantly oceanic climate, but also in NE Poland, under much more continental climatic conditions and even reached Lithuania. The several individuals registered there underline the existence of a population in this area rather than displaced single individuals. Intensive faunistic search is necessary to assess the distribution range and its dynamics of *Phaneroptera falcata* in this region.

The eastward continuation of the northern borderline of *P. falcata* through Belarus and the European part of the Russian Federation also needs more faunistic research efforts. According to the map in Willemse (2007), *P. falcata* is not yet known from Belarus. In Ukraine, the exact northern borderline has yet to be assessed but runs, according to Kotenko (in litt., November 2010), between 52 and 53N. In the European part of the Russian Federation, it is marked by localities situated approximately on a similar latitude as the formerly known Polish findings, e.g. Sevsk (Fig. 3: 12), Kursk (Fig. 3: 13), and Lipetsk (Fig. 3: 14) in the southern part of the Ryazan area (Bey-Bienko 1954). A newly collected voucher specimen from the southern part of the Bryansk area close to the Ukrainian border (Chukrai village, district of Suzemka, 52.19N; 34.05E, collected by one of us (PG) in July, 2010 and also deposited in ZFMK's Orthoptera collection), roughly fits this distributional pattern (Fig. 3: 11), which ranges between 51 and 51.40N in the Asiatic part of Russia (Bey-Bienko 1954, 1964). It can be assumed, however, that *P. falcata* will extend its northern distribution borderline also in these parts of its range.

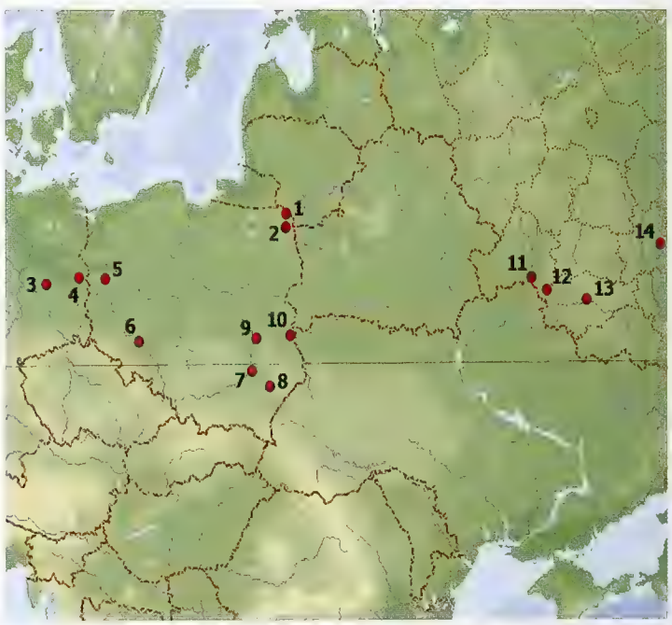

Fig. 3. Map showing the northern part of the distribution range of *P. falcata* in the eastern Central and East European realm, our new record (2) and the one from Lithuania (1) being the northernmost sites. **1.** Lazdijai District (LIT); **2.** Wigierski National Park (PL); **3.** Treuenbrietzen (D); **4.** Berkenbrück (D); **5.** Lubuski Province (PL); **6.** Wroclaw (PL); **7.** Nizina Sandomierska (PL); **8.** Roztocze National Park; **9.** Pulawy (PL); **10.** Polesie National Park (PL); **11.** Chukrai (RUS); **12.** Sevsk (RUS); **13.** Kursk (RUS); **14.** Lipezk (RUS). Map: P. Wagner.

Acknowledgements. The authors are indebted to Prof. Dr. Zbigniew Szyndlar and to Dr. Elsbieta Warschowska (both from Kraków), as well as to Ryszard Orzechowski (Zielona Góra), and to Tatiana Kotenko (Kiev), for valuable advice and literature references. PG thanks Igor Palko (Moscow) for the invitation to Chukrai village.

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Erratum to: Sonnenberg & Busch (2010) Description of *Callopanchax sidibei* (Nothobranchiidae: Epiplateinae), a new species of killifish from southwestern Guinea, West Africa

Rainer Sonnenberg [1,2] & Eckhard Busch [3]

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Erroneously the name of the new species was formed as a noun in genitive case for a single male person (ICZN, Article 31.1.2), however, in the text it refers to:

.....The new species is named after Mr. Samba Sidibe **and** his family.... (Sonnenberg & Busch 2010, p. 11, bold introduced here for clarification).

Therefore the species name should be formed in plural with the ending *-orum*.

In accordance with the International Code of Zoological Nomenclature (4th Edition, 1999), Article 32, we propose as correct species name *Callopanchax sidibeorum*.

Acknowledgements. We thank Wolfgang Böhme (ZFMK, Bonn) for alerting us on this mistake in the publication and his advice for this Erratum.

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Sonnenberg R, Busch E (2010) Description of *Callopanchax sidibei* (Nothobranchiidae: Epiplateinae), a new species of killifish from southwestern Guinea, West Africa. Bonn zoological Bulletin 57: 3–14

Brandt T, Jülch C, Wasmer K, Moning C, Wagner C (2011) The Top 50 sites for birdwatching in Germany. (Die 50 besten Vogelbeobachtungsplätze in Deutschland). Der Falke. Aula-Verlag, Wiesbaden. ISBN 978-3-89104-746-0. 19,95 €.

This book is published as a special issue of one of the leading German birdwatcher's magazines, "Der Falke", and large parts of its contents have already been published in single articles of the journal. It presents the 50 best sites for birdwatching in Germany. Each single chapter gives an overview about typical habitats and interesting bird species and some logistical advices of the where and when of birdwatching at the spot. Sometimes, interesting additional information on other cultural or natural study activities in the region is given. Boxes show "How to get there" and give useful local contact addresses. In contrast, explicitly stated GPS coordinates are often not very helpful as they regularly do not show the particular spots from where to find the birds (e.g. a hide) but the center of the next village. A register at the end of the volume shows which rare species occur at each site. A Top 50 list of sites can always be debated. However, it is a pity that some species which are much sought after are not covered by the selected sites (e.g. Rock Bunting) or are not mentioned at suitable sites (e.g. Cirl Bunting). Nice photos and maps make it a pleasure to browse in the well illustrated book and to think about the next short trip. However, if you are seriously interested in birdwatching in Germany, the three volume book "Vögel beobachten in Nord-, Süd- und Ostdeutschland" published by Kosmos and written by members of the same author team might be a better and more comprehensive (but more expensive) choice. Germany still lacks a concise English "Where to watch birds" guide, and authors and editors sadly failed to fill this gap. Instead, recycled material was used to write a nice although not really essential book for birdwatchers.

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Bonn zoological Bulletin (BzB)

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Kottelat M, Whitten T, Kartikasari SN, Wirjoatmodjo S (1993) Freshwater fishes of Western Indonesia and Sulawesi. Periplus Editions, Hong Kong

Mayr E (2000) The biological species concept. Pp. 17–29 in: Wheeler QD & Meier R (eds.) Species Concepts and Phylogenetic Theory – A Debate. Columbia University Press, New York

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Appendix Appendices should be numbered consecutively in Roman numbers, in order of their mention in the text (Appendix I, Appendices I–VI).

Abbreviations Except of very common abbreviations such as mm, kg etc.; all abbreviations should be explained in the Methods section or figure legend if appropriate. Hyphenation or upper case letters for entire words are not permitted. All measurements must be metric units and given to the same decimal, i.e., 5.3–6.0 mm (not: 5.3–6 mm).

Taxonomy Names of animals and the description of new genera or species must follow the current version of the International Code of Zoological Nomenclature (ICZN, available at http://www.iczn.org/iczn/index.jsp). Type specimens should be deposited in recognised institutions; deposition at ZFMK is highly appreciated. Italics are required for species names which are written in full the first time they appear in the text, e.g. *Carassius auratus* (Linnaeus, 1758), but abbreviated at subsequent mention, e.g. *C. auratus*. List names in synonymies as follows: *Attelabus asparagi* Scopoli, 1763 (Scopoli 1763: 36, fig. 113.), and list the source under References. Dichotomous keys are desirable in taxonomic papers.

Statistics Statistics presented should include the name of the test, number of observations or degree of freedom, and probability level ($P > 0.05$, $P < 0.05$, $P > 0.001$, $P < 0.001$). Values of test statistics are not required.

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Cover illustration:
Naja sumatrana Müller, 1890 from Pangkor Island, Peninsular Malaysia
(this volume, pp. 3–8)

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